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WORLD OIL and The COMPOSITE CATALOG
for the drilling-producing-pipe line industry

PETROLEUM REFINER and THE REFINERY CATALOG
for the refining-natural gasoline industry

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FOR OIL INDUSTRY CHEMICAL SERVIC

A WONDERFUL OPPORTUNITY

THE PETROLEUM INDUSTRY will stage a concentrated public relations program during the week of October 11 and particularly on the day of October 14. General plans have been prepared by the Oil Industry Information Committee and now are in the hands of district committees.

The plan is to point out to the public what the oil industry contributes to the social and business life of the people and communities of the U. S.; and to tell the story of the accomplishments of the industry in the face of soaring postwar demands. In addition, individual companies are urged to tell what they—as well as the industry as a whole—have done in serving individual communities and regions. These things are to be accomplished through speeches at business clubs and radios, by distribution of prepared literature, and by newspaper advertisements and publicity.

All the above is to be done by local oil men on a "grass roots" community basis, city by city, town by town, and village by village. In this way the people can be shown how important the oil business is to them individually and collectively.

Here is an opportunity to tell millions of people in one day the facts which prove that as a free, competitive business the oil industry is giving great social and industrial benefits to the greatest number of people in America. The total effect of the undertaking should make a great impact on public understanding. In every community where real effort is made, there will be a resulting increase in recognition of the many advantages and benefits all persons receive from the oil industry as it is now operating.

In the words of Ralph C. Champlin, chairman of the Oil Industry Information Committee, "We sincerely believe that there is no more valuable use for an hour of an oil man's time than to use it now to prove why the public should continue to support a free and vigorous oil industry."

This is a bold plan. Much work necessarily will have to be put into the effort. Thousands of hours will be required. This means that the cooperation of a substantial percentage of the oil industry people will be needed. As many as 10,000 oil industry representatives should take part. Each district must be organized. In each district a considerable number can be helpful by influencing other oil men to participate in some part of the program. Many will be needed to speak before hundreds of civic and business clubs in each state. There also is the task of securing time with civic clubs and radios.

Officials of every oil organization—in every branch of the industry throughout the nation—should immediately let their employees know that their cooperation in this big job of telling the facts about the oil industry is important. Every company official, particularly of smaller concerns, who may not yet have been contacted, should voluntarily offer his assistance to some member of the Oil Industry Information Committee in his respective district. There is a wide variety of work to be performed; therefore everyone can fit into some part of the program. Members of the district committees will gladly explain the whole plan and welcome your participation. If you do not know the address of your district committee, this magazine will be happy to furnish it.

Working together, the industry can attain much favorable attention and public understanding.

HARRY C. WIESS

THE DEATH of Harry Carothers Wiess, 61, Chairman of the Board of Humble Oil & Refining Company, on August 26, removed another of the petroleum pioneers of the Southwest. He had his first contact with the oil industry at Spindle Top. As a young man he headed his own company which was one of several to be merged more than 30 years ago to help create what is now Humble Oil & Refining Company.

Harry Wiess was a shy person whose good instincts were directed in a score of directions. He gave generously of his time and his fortune to educational, charitable and cultural enterprises.

Princeton University, his alma mater, and Rice Institute, of which he was vice-chairman of the board, both are indebted to him for highly constructive help. Local charities always counted on him for generous assistance.

But his outstanding characteristic, we think, was his burning desire that the men and women in his organization, the Humble "boys and girls" be a happy group—and the esprit de corps of that organization is due in no small part to this desire of his.

From a scientific standpoint he was one old timer who zealously welcomed every new application of science to his business.
He will be missed in his community and in the oil industry.

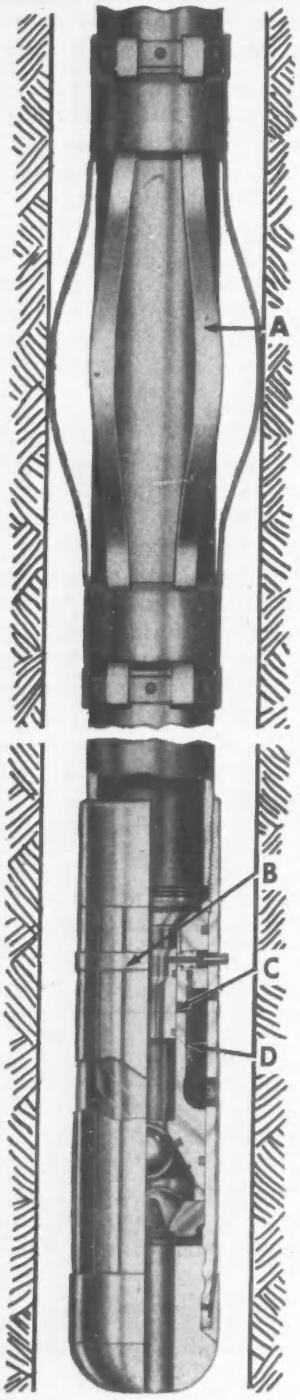
Ray L. Dudley

WITH A

BAKER *Triplex* CEMENTING SHOE...

You secure a good "first-time" cement job while protecting permeable low-pressure zones below the shoe from contamination.

Here's how it is done . . .



A Baker Casing Centralizers (Product No. 910) are installed on, and above, the shoe joint to center the casing and provide a uniform annulus to receive the cement slurry.

B A hold-down strap (secured by shear screws) retains the Baker Metal Petal Basket close against the shoe or collar while running-in the casing and conditioning the hole.

C Cementing ports are covered by the Tripping Valve until cementing is commenced.

D A fabric-reinforced, resilient rubber, sleeve-type, back-pressure valve opens readily (see dotted white line) to permit passage of the cement slurry into the annulus above, but closes instantly to prevent any return flow of the slurry.

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F Shearing the screws also releases the Basket hold-down strap and allows the Metal Petal Basket to expand outwardly against the wall of the hole. The Basket with which each Triplex Shoe is equipped has a wide range of expansion and forms a bridge in large-diameter, or irregular-shaped holes far beyond the range of a rubber packing element.

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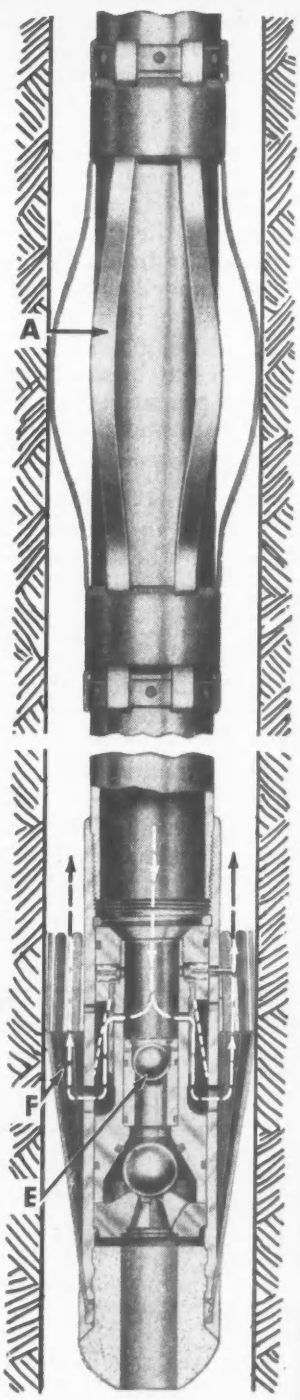
Only readily drillable materials are used for all internal parts; and two one-half inch set screws hold the inner assembly stationary to facilitate drilling out.



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The Changing Panorama

Oil Demand Met; Prices Stable

SOME OF the items that go into the cost of petroleum products have shown further increases in recent months, putting additional upward pressure on the industry's prices.

Various oil companies have negotiated new contracts with oil workers' unions, agreeing to increase wages 12 to 18 cents an hour. Rig builders and other workers associated with the industry also have gained increases. Prices of steel goods used by the industry have been marked up within the past two months. Effective October 16, the Ethyl Corporation will increase by 7½ percent the price of its antiknock compound for use by oil companies in automotive gasoline, and the compound used in aviation gasoline will be advanced 7 percent, due to further increases in the cost of metallic lead, other materials, and wages. (Since 1945 the cost of metallic lead has increased from 6½ cents to 19½ cents a pound.)

Oil prices are buoyed by the same inflationary forces that affect all other prices, and there is still instability in the general price situation. In the week ended July 17 the government's index of all commodity prices was at a new peak of 168.9 percent of the 1926 average. Subsequently there were slight decreases as farm products and foods eased off, but the index was still at 168.3 on July 31. Large U. S. crops of corn, wheat, and cotton and improved European grain crops promised to prevent further increases in prices of these commodities. Slightly tightened credit in the U. S. due to mild governmental anti-inflation measures promised to act as a brake on prices.

Helping to offset increased material and labor costs in U. S. industries were record-breaking volumes of production and sales, including sales of petroleum products. While oil companies' costs of materials and labor have been increased in recent months, as stated above, the volume of oil products produced and marketed have been the greatest in the history of the industry. Consequently, oil company earnings have been exceptionally high, affording good dividends to stockholders besides raising large proportions of the funds needed for the vast and costly program of expansion of facilities of the industry.

These new facilities, including new pipe lines as well as new refining facilities and producing properties, already are beginning to pay off in greater volumes of oils available for the consumers. Slowly but surely, crude production, refinery runs, and pipe line movements of oils have been stepped up, until there is now less danger of serious shortages of oils, despite the fact that unprecedented demands are being met.

There seems to be at present somewhat less threat of another crude price increase than there was two months ago, as more and more crude production has come forth to satisfy refinery requirements, in response to the relatively attractive prevailing prices.

Competitive free enterprise in the industry, reacting to the existing conditions of supply and demand and the free movement of prices, is supplying the oils that the consumers want. Fortunately, it appears that petroleum prices may have gone as high already as they will have to go to keep supply abreast of demand.

Role of Management In PR Program Vital

AN EXTREMELY important phase of public relations which is too often overlooked is that of fully acquainting all members of a company's management with the program and its importance.

In this connection, Stanolind Oil & Gas Company recently has embarked upon a noteworthy program. The company is holding a series of meetings in each of its operating divisions or districts to acquaint its entire management with the problem of public relations. For example, 120 members of the firm's top management in the Texas-Louisiana Gulf Coast division met in Houston on August 18 and 19. They heard Walker A. Strong, of the Opinion Research Corporation, present a talk on public opinion trends and their importance to business policy. An open discussion also was held to determine ways and means by which the company could improve its relations with employees and the general public.

Beneficial results will come from having so many of the company's management informed and acquainted with ways of improving relations. It is hoped that other oil companies will follow the example established by Stanolind Oil & Gas Company.

Peak Output Reduces Threat of Shortages

WITH BENEFIT of the expansion in domestic production, the industry so far has forestalled the petroleum product shortages that were threatened for the latter half of this year. One of the results of the unprecedented production has been the growing and harvesting of the largest crop in U. S. history without shortages of petroleum products, according to petroleum distributors serving the wheat and corn belt of the country. Motorists have been able to purchase gasoline everywhere and at all times, although local, temporary shortages were threatened. There may yet be shortages of heating oils during the coming winter, but this threat is being reduced by the industry's vigorous efforts to make larger supplies available. Stocks of fuel oils are somewhat greater than at this time last year, and current production is great enough to hold inventories at favorable levels. It will be necessary for the consumers to practice conservation in their use of heating oils next winter, or else a shortage could occur, especially in the event of abnormally cold weather. However, if the public will cooperate with the industry by avoiding waste of fuel oil, supplies very likely will be sufficient to meet requirements.

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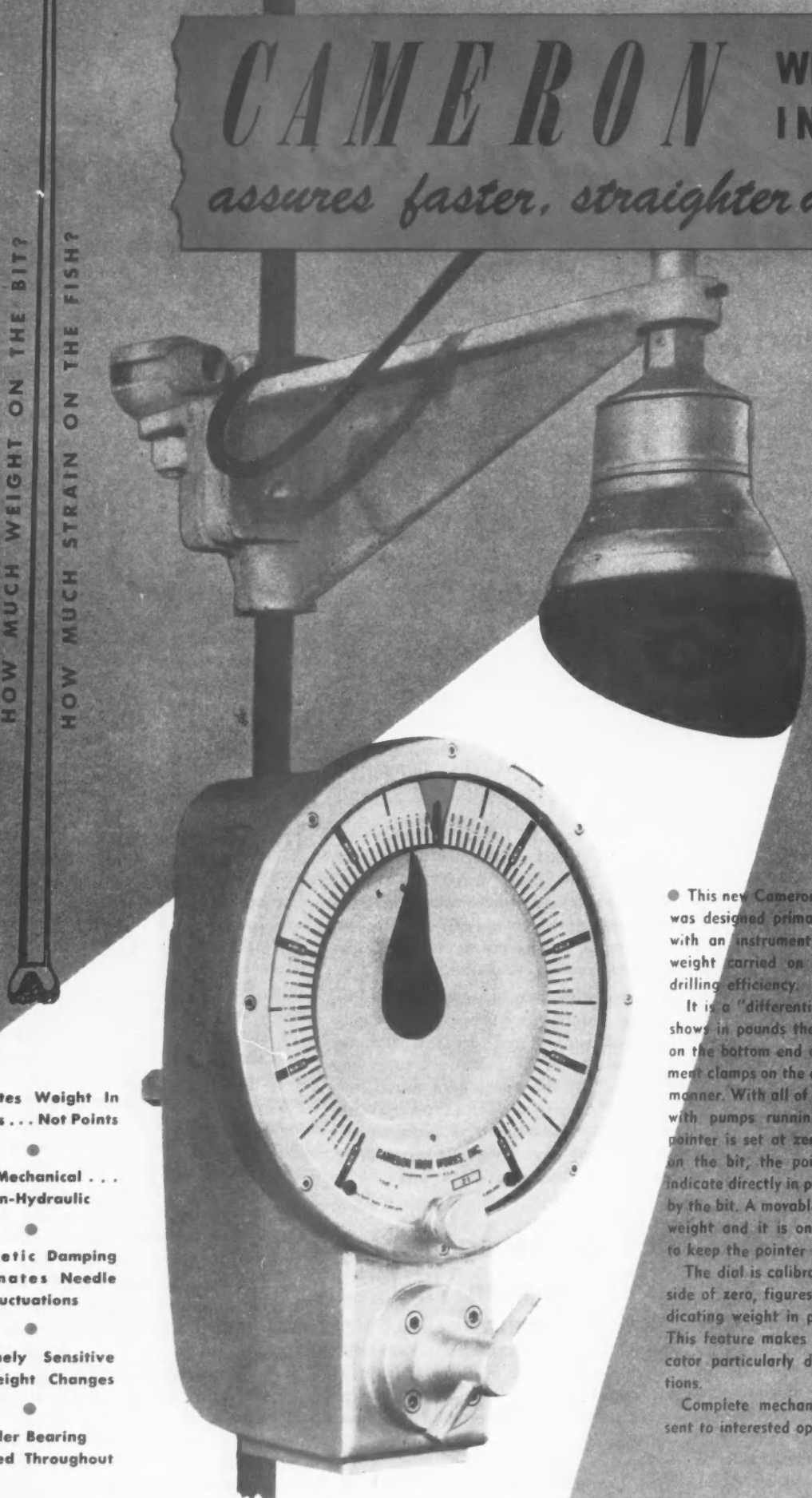

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MONTHLY NEWS ANALYSIS

ALLOCATION PLAN ENACTED . . . GAS SHORTAGES PREDICTED FOR WINTER
INCREASE IN OIL AND GAS CONSUMPTION BLAMED ON HIGH COAL PRICES
CONGRESS ASKED TO REPEAL AUTO TAXES . . . OIL TO BE FIFTH OF ERP AID

New System for Allocation Of Oil Supplies Authorized

A new plan is now in effect for voluntary allocation of petroleum products by the oil industry. Approved at the middle of August by both the Secretary of Interior and the Attorney General, the plan became effective immediately and will last until next February 28, unless terminated earlier by the Secretary of the Interior. Authorized by the Taft anti-inflation law, Public Law 395, the agreement replaces the temporary one in effect from January 28 to June 15 of this year.

The agreement states that the voluntary allocation plan for petroleum is necessary because it appears that during the latter half of 1948 and the early months of 1949 "the supply of petroleum products may be insufficient to satisfy the essential requirements of all domestic consumers in all areas throughout the country." Similar plans previously have prevented economic dislocations from fuel shortages, the agreement continues, and it is expected that the present plan will do the same.

Before he would approve the new plan and thus give participants immunity from prosecution under the anti-trust laws for their concerted action, the Attorney General insisted that several changes be made in the plan as proposed by the industry, and wrote into the plan certain safeguards against monopolistic action.

Under the plan each member of the petroleum industry promises to "equitably distribute" his available supplies of gasoline and other motor fuels, kerosine, distillates, and heavy fuel oils among all customers, at all levels, after fulfilling certain essential military, transportation, and public health service needs. In determining this "equitable distribution, he shall give primary consideration to his pattern of distribution among customers of preceding years."

The National Petroleum Council is authorized to appoint district committees representing all segments of the petroleum industry. These committees can make studies on supplies and demand for petroleum in their districts and can make recommendations for voluntary action by the industry "for adjusting the refinery yields of petroleum products" to prevent disruptions or to alleviate hardship at consumer levels. "Such recommendations may also deal with purchases, exchanges, loans, transportation agreements, or other measures which such committee may deem appropriate . . . for relief of hardship situations on the consumer levels."

The agreement also calls for continuance of programs by the industry for getting consumers to conserve fuel oils and other petroleum products.

To remove objections of the Attorney General, the new plan requires that each supplier must make known to his customers at least every three months the formula he is using for "equitably allocating" his products.

Stanolind Discontinues Plans For Synthetic Gasoline Plant

A severe setback to the nation's synthetic fuels industry was received with the announcement by Stanolind Oil and Gas Company, Tulsa, that it has discontinued plans to build a multi-million dollar synthetic gasoline plant at Garden City, Kansas. The estimated capital investment required for the project has more than doubled since the program was first planned two years ago, company officials estimate.

The big plant was to manufacture 6000 barrels of gasoline and diesel fuels and 400,000 pounds of chemicals daily from dry natural gas from the Hugoton field; the chemical plant was to refine the chemicals manufactured; and the synthetic gasoline plant was to process 100 million cubic feet of gas daily.

Final Judgment Entered

Final judgment giving the Gulf Publishing Company the right to use the name "World Oil" for one of its publications has been entered in the suit filed in California by *World Petroleum.*

Lack of Pipe to Result In Winter Gas Shortage

Because of the lack of line pipe to expand transmission facilities, there will be continued shortages of natural gas during the coming winter, especially in the Eastern and Middle Western regions. As during last winter, some domestic and commercial consumers as well as industrial plants will have less gas than they want, in spite of the expansion of facilities that the utilities have been able to make this year.

Faster than pipe line systems can be enlarged, installations for using gas have been increasing. It may be years before supplies can be made equal to demand, considering the shortage of steel for building new pipe lines.

Shipments of domestic gas ranges illustrate the fact that gas-consuming equipment can be increased more rapidly than gas supplies can be expanded. In the first five months of this year, shipments of domestic gas ranges were 24.3 percent greater than during the corresponding period last year, according to the American Gas Association. Shipments of gas ranges for use with liquefied petroleum gas constituted approximately 26 percent of the total shipments and were 28.2 percent higher in the first five months of 1948 than in the corresponding months of 1947. Thus "bottled gas" as well as the natural gas distributed by the utilities is being demanded in increased amounts and will be scarce next winter, when use for heating is added to other uses.

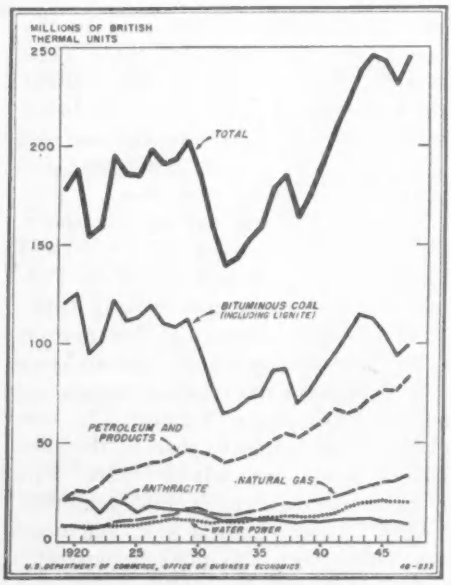
In anticipation of natural gas shortages next winter, some of the present Eastern consumers have urged the Federal Power Commission to deny applications of gas companies for permits to build certain new pipe lines to serve new customers until present users are assured adequate supplies. It was claimed, for instance, that in the Cincinnati area last winter there were plant shutdowns and unemployment for lack of enough natural gas; and users asked that such situations be corrected before attempting to supply new markets.

High Prices of Coal Cause Greater Use of Oil and Gas

Developments in the coal industry directly affect the petroleum industry and the natural gas industry, it is brought out in an article in the July, 1948, issue of the Department of Commerce publication, *Survey of Current Business*. Title of the article is "Changing Patterns of Fuel Consumption." Text and charts show that since World War I there have been steady increases in the per capita consumption of energy from petroleum and natural gas, some increase for water power, but a net decrease in per capita consumption of energy from both anthracite and bituminous coal.

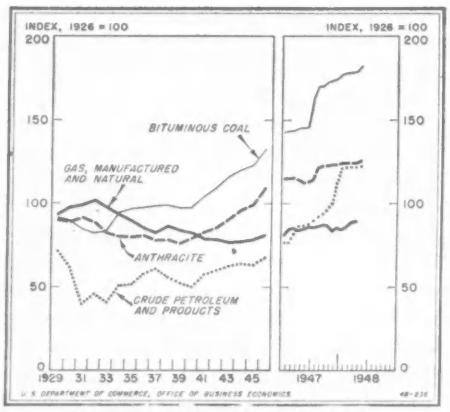
Importantly responsible for these trends in use of the different fuels have been the relatively lower prices of petroleum products and gas. Prices of bituminous coal have been steadily increasing since the early 1930's, as costs have risen because of unionization in the industry and efforts of the industry and the government toward price stabilization. Prices of petroleum products were relatively low throughout the 1930's and until after World War II, when they increased because of difficulty in providing supply equal to demand, with many consumers turning from high priced coal to oil for fuel and thereby accentuating oil scarcity.

Similarly, high prices of coal have greatly stimulated demand for natural gas, selling at relatively low prices, making it impossible for gas companies to meet all demand under existing shortages of pipe for expanding facilities. While a group of electric utilities using coal experienced an increase of 71 percent in fuel costs per thousand kilowatt-hours from 1939 to 1947, another group of utilities using natural gas had a 9 percent decrease in unit fuel costs. The relatively low prices of natural gas, due in large part to governmental fixing of rates, tend to reduce demand for coal while stimulating demand for the gas.



Per capital consumption of energy from mineral fuels and water power.

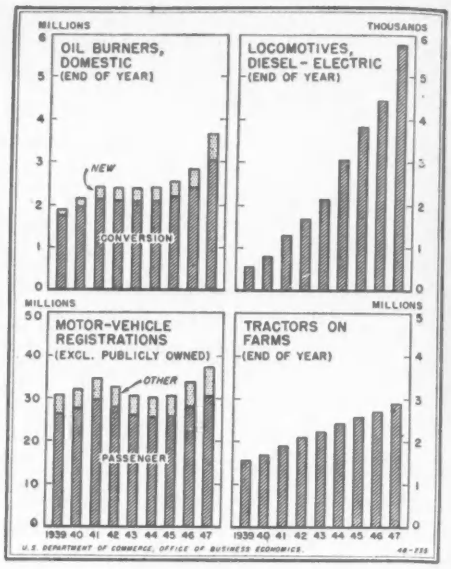
From 1939 to 1947 there was a 62 percent increase in domestic consumption of all petroleum products, a table showed. But gains for different products varied as use of motor fuel rose 43 percent, kerosine 69 percent, fuel oil 78 percent, lubricating oil 60 percent, and all other products 80 percent. Within the fuel oil category, the lighter oils or distillates, used largely for heating purposes, increased 121 percent, while the heavier oils or residual oil, used to a greater extent for industrial purposes, increased only 60 percent from 1939 to 1947.



Wholesale prices of mineral fuels.

A chart, here reproduced, showed recent growth in use of certain types of petroleum-using equipment in order to help explain the changes in the consumption of some of the more important petroleum products. Competition between coal and oil is reflected in the field of residential heating, where consumers have taken advantage of the conveniences of oil in central heating systems instead of hand-firing coal. Mechanical stokers have facilitated use of coal, but this equipment has grown in use much less than oil burners. Number of residental oil burners in use at the end of 1947 was two-thirds greater than before the war. Bulk of this increase has occurred through burners used for converting central heating systems to oil. In 1947 shipments of residential burners were four times the 1941 rate. But with light fuel oil supplies tight in 1947 and 1948, sales of oil burners have sharply declined in 1948. Shipments of residential burners in the first quarter of 1948 were less than one third of the 1947 first-quarter rate, and unfilled orders at end of the quarter were only one-tenth their size 12 months previously.

Motor fuel consumption has increased



Growth in petroleum-using equipment.

less than use of other products, reflecting the wartime interruption of automobile manufacture. The number of passenger cars in use during 1947 was only one sixth greater than in 1939, although for trucks the increase was almost 50 percent.

High farm income during and since the war spurred the upward trend in farm mechanization and in use of petroleum products on farms. The number of tractors in use on farms increased by 90 percent from 1939 to 1947. Demand for tractors has continued in excess of supply, even though tractor production was maintained at high rates during the war to help meet wartime food goals. Fuel for tractors is primarily gasoline, but some tractors use diesel oil, distillate, or tractor fuel.

Diesel electric locomotives have shown the sharpest increase in use of any of the important types of petroleum-consuming equipment. Production was maintained during the war to meet the acute need for railroad motive power. At the end of 1947 the number of diesel electrics in use on Class I railroads was 5772, compared with 525 at the end of 1939.

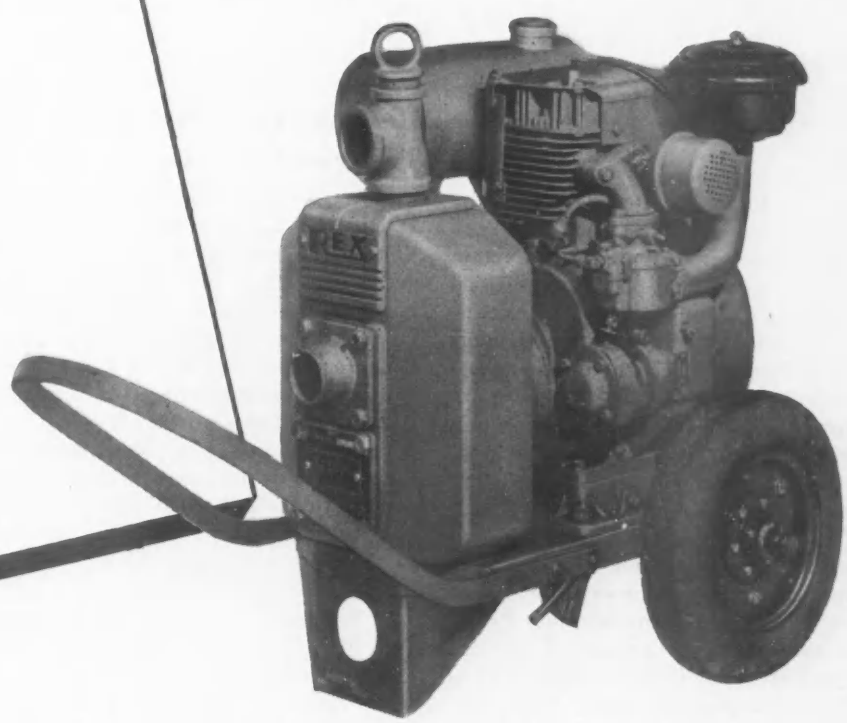
Shell Oil Company Film Is Service to Industry

In view of the great emphasis now being placed by the industry on gaining favorable public opinion, an important service to the industry is being performed by Shell Oil Company in making available its revised version of a sound film titled "Oil for Aladdin's Lamp." The movie dramatizes the achievements of the industry and the petroleum scientists. The film is available for showing on requested dates to schools, churches, lodges, and club groups.

THERE'S A NEW LITTLE YELLOW PUMP . .

The "Easy-Flow" Rex!

- IT'S NEW
- IT'S DIFFERENT
- IT'S DURABLE
- IT'S EFFICIENT
- IT'S LIGHT
- IT'S FAST
- IT'S HANDY



Light weight . . . outstanding durability . . . top efficiency, the new Rex "Easy-Flow" Pump gives you all three and then some. It's the ideal pump for oil field utility service.

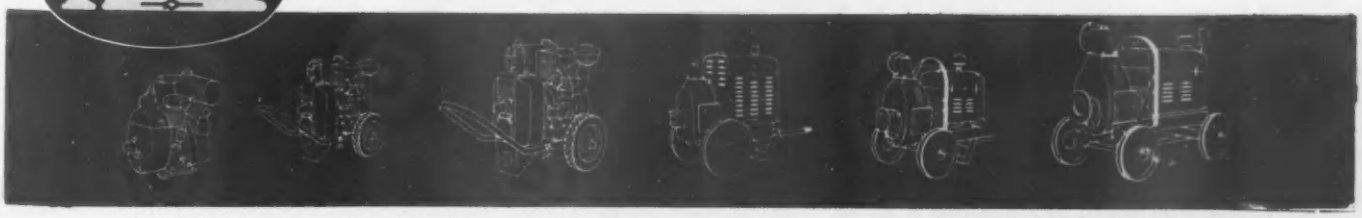
The pump body is press-formed of Armco Ingot Iron, famous for resisting rust and corrosion. This new body won't crack or shatter under heavy blows . . . or in freezing weather.

The Rex "Easy-Flow" Pump is the fastest priming, most efficient pump in the field today. The press-formed body and volute have smoother surfaces, assuring faster flow of water through the pump. There is no re-circulating shut-off valve, eliminating wasteful re-circulation. If damaged, body can be repaired by welding.

Combine all these advantages, plus the famous Rex adjustable Z-Metal Peeler and Z-Metal Impeller, and it's easy to see why you'll get a new high in long service life.

For all the facts, see your Rex Field Engineer, your local Supply Store, or write Chain Belt Company, 1639 West Bruce St., Milwaukee 4, Wis.

REX **OIL FIELD PUMPS**



CHAIN BELT COMPANY of MILWAUKEE

Reports Indicate California Can Meet West Coast Needs

Although there has been in the past some doubt about the ability of California to continue supplying sufficient petroleum products for the Pacific Coast region, a study of recent reports of the U. S. Bureau of Mines indicates that petroleum demands on the West Coast can be met at least through 1948 without shortages.

With proper restraint by consumers to avoid waste and extravagance, there is good assurance that even the currently high level of demands can be met without hardship or rationing. There should be sufficient gasoline the rest of this summer and fall and also enough heating oils next winter, although supply will not permit prodigal use.

California's crude oil production has reached 950,000 barrels daily and is still rising. It is expected to reach 960,000 barrels per day by the end of the year. Important discoveries in the Cuyama Valley and at Lost Hills may boost output even higher. Production in prewar years was 600,000 to 650,000 barrels per day, and domestic consumption absorbed only about three-fourths of it. Domestic consumption subsequently has doubled, and still there are sufficient supplies to permit exporting between 5 and 10 percent of the total to Canada, Hawaii, and other Pacific areas.

Total supply of raw materials and products, including some small imports of lubricating oil and other commodities from the Mid-Continent and Rocky Mountain areas, is running 4 percent above last year. Total demand is running only 2 percent higher. Therefore, stocks are increasing a little.

West Coast stocks of all oils at beginning of this year were about 90 million barrels, and by end of this year they likely will reach 100 million barrels. Prior to the war a surplus of oil caused stocks to reach the excessive level of 164,110,000 barrels in 1939. Considering greatly increased demand, a level of 100 million barrels now is barely comfortable. Most of the oil being added to storage is heavy residual fuel, unsuited to home heating. The balance between supply and demand is delicate for both light fuel oil and motor fuel. While a balance seems reasonably sure at this time, the outlook might be changed in one direction or the other within a few months by unforeseen developments, such as large military demands on the one hand or large new discoveries of gasoline-bearing crude on the other hand.

Gasoline demands upon the California segment of the industry are running 4 to 5 percent above last year and show some signs of leveling off. Vacation travel so far this year has not been much above last year, although increased travel in the closing part of the vacation season is widely anticipated.

Residual fuel oil demands are 7 to 8 percent below those of last year. There are two principal reasons for the decrease. First, the long-delayed spring rains replenished the storage behind dams where electric power is generated. Second, more natural gas is available this year, from local supplies and from West Texas.

In summary, supplies of heavy fuels have loosened up considerably, with inventories now increasing. Supplies of gasoline and light fuels are close to balance with demand, and no shortages appear likely.

Highway Users Ask Congress To Repeal Automotive Taxes

More than 600 state and local organizations of highway users have petitioned Congress to repeal the federal automotive excise taxes which are partly blamed for the increased cost of automobiles. The National Highway Users Conference, backed by 32 national organizations headed by the American Automobile Association, points out that with the passing of the war emergency these taxes which are currently being collected at a billion-dollar annual rate and are being borne by every motorist in the prices he pays, should be abolished, because:

1. They increase prices to consumers.
2. They increase automotive costs and will ultimately limit the use of vehicles so that remaining vehicles will be required to pay a bigger share of taxes.
3. Excise receipts go into general revenues and are not earmarked for highway use. Thus they infringe on a state sphere of taxation and create a duplicating tax machinery.
4. Automotive excise taxes are discriminatory between different forms of transportation. Truck and bus companies pay these special taxes on new equipment and the oil, gas and tires they use, as do passenger car operators, but other forms of transportation are exempted.

The National Highway Users Conference points out that federal automotive excise taxes began as emergency levies and that their continuation could mean the scuttling of the original theory of Federal aid, under which Federal aid was not made contingent on special taxes. Furthermore, as a tax-paying group, highway users already bear the responsibility of special state taxation.

Transportation Facilities Expanding to Meet Needs

Transportation facilities continue to be expanded as an important part of the general expansion of the petroleum industry. These projects are equally as important as increased drilling and refinery construction.

Transportation was a bottleneck in the latter half of 1947. Difficulties were experienced in finding enough tankers for supplying the East Coast, and there were shortages of pipe line capacity and barges for moving oils to the Middle West. Some expansion of pipe lines from producing centers to the Middle West has been completed, but various major projects are still under construction and will not come into operation until later this year and early in 1949.

Tanker capacity was found inadequate in 1947 to supply the East Coast, which normally gets 95 percent of its oil supplies from the Gulf Coast and the Caribbean area. Late in 1947, therefore, the industry commissioned 264 tankers from the Maritime Commission. They were put in operation as soon as repairs and other changes could be made. By the end of last February practically all tankers were operating. Capacity is believed ample now to provide for oil movements into the East Coast and to meet 1948 demands. Several companies have placed orders for construction of some super-tankers, capable of carrying about 240,000 barrels of oil each, or a little more than double the capacity of the present T-2 type tankers. The new tankers will be faster as well as larger. But they will not be in operation for a year or more.

Several companies continue to move crude oil and products into the Middle West by tank car, even though this method is more expensive than either pipe line or barge. These movements will be necessary until new pipe lines, now under construction, come into operation later in 1948 and early in 1949.

Oklahoma Projects Show Value of Unit Operation

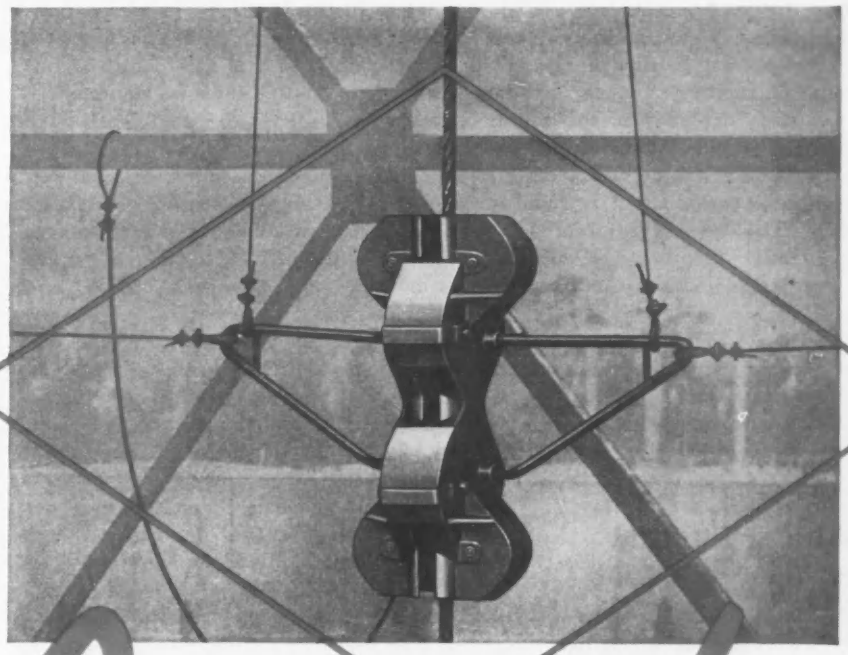
Unit operation of high gas/oil ratio oil fields is paying off for Oklahoma royalty owners and producers, and successes are expected to encourage other oil-producing states to enact compulsory unitization laws similar to that now operating so effectively in Oklahoma.

A year ago approximately 300 million cubic feet of casinghead gas was being vented every day from two high gas/oil ratio pools in Oklahoma, including the four-county West Edmond Hunton Lime pool, which accounted for more

Make Wire lines Behave

with the new

PATTERSON-BALLAGH



Roliguide

PROTECT YOUR RIG FROM WIRE LINE WOBBLE

Wire line whip causes uneven spooling and piling up of the line on the drum. Kill this whip and reduce chances for wire line trouble with the NEW Patterson-Ballagh ROLIGUIDE. This roller type Wire Line Guide operates in freezing weather and easily handles both dry and lubricated lines.

Vibration and whip do not have a chance when you install the new Patterson-Ballagh ROLIGUIDE on your rig. The greater over-all length of the Guide and the large number of rollers give the stability that efficiently kills vibration. Each of the eight rollers rotates on two races of grease packed, over-capacity ball bearings. They absorb the vibration and transmit a larger portion of it to the body of the Guide and the hanging assembly. Each long-wearing roller is completely housed in the body so that it *can not* drop out or throw oil on the crew or rig.

EACH ROLLER, code: ROLIFILL, is covered with tough, long-wearing rubber. Easily replaced in Wire Line Guide. Additional rollers furnished on order.

For more information on the ROLIGUIDE, write for free bulletin or call your Patterson-Ballagh man today!

Refills for ROLIGUIDE, code: **ROLIFILL**

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WIRE LINE GUIDES

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T.I.P.S.A., Santiago-del Estero 286, Buenos Aires, Argentina . H. F. Towler, 9 Cavendish Square, London, W1, England.

than half the waste. This represented a heavy day-to-day loss in money, and still more important, it also represented dissipation of reservoir energy which threatened early depletion of this major pool. As a result of unitization, gas venting at West Edmond has virtually ceased, while oil production is steadily increasing. The West Edmond Unit became effective October 1, 1947, and it was the first field to be unitized by statute.

Conservation officials and production engineers agree that effectiveness has been demonstrated, and plans are under way to apply the statute to other areas where high gas/oil ratios are uncontrolled.

One-Fifth of ERP Aid To Be Oil and Oil Tools

Of the $5 billion to be spent by the U. S. in the first year of the operation of the European Recovery Program, $1 billion, or 20 percent, will be used for petroleum products, petroleum transportation, and petroleum industry equipment.

The program is being administered by the Economic Cooperation Administration, headed by Paul G. Hoffman, and the petroleum and petroleum equipment phases are handled by a petroleum division of the E. C. A., of which Walter Levy is director. He was formerly with Socony-Vacuum Oil Company but resigned to handle the government job.

E. C. A. is basically an operation to cover deficits in dollar exchange in Western European countries, enabling them to purchase essential goods and services from Western Hemisphere countries. Help given through E. C. A. is in the form of grants, loans, and technical and other assistance. The European countries submit programs indicating their needs and the dollar help they seek from the U. S. The requests are carefully studied and screened down by E. C. A. to conform with availability.

Original requests amounted to about 1.2 million barrels per day of petroleum imports for 1948. They were screened down to about 900,000 to 950,000 barrels daily for the first year of the program. E. C. A. then had the job of determining how much of the 900,000 to 950,000 barrels a day of total imports needed could come from the European countries' own sources, so-called sterling sources, and how much would have to come from dollar sources. The division was 525,000 barrels from sterling sources and 425,000 barrels a day from dollar sources.

Dollar sources do not mean exclusively U. S. sources. They mean supplies for which dollars have to be paid. E. C. A. is under mandate from Congress to limit as much as possible shipments from the U. S. and to avoid burdening our domestic economy more than absolutely necessary.

Of the 425,000 barrels a day to be obtained from dollar sources, about 95,000 a day would come from the U. S., including large quantities of specialty products, which cannot be obtained elsewhere.

About 39 percent of total supplies to Europe in 1948, it was estimated, would come from Middle Eastern sources, provided the Middle East remained an area where the program could operate. Supplies from the Middle East were scheduled to go up to about 80 percent in 1952. Supplies from the Western Hemisphere were scheduled to go down from about 61 percent in 1948 to 20 percent in 1952. The share of the U. S. in total Western Hemisphere shipments to Europe was expected to go down considerably.

E. C. A. is not a procurement agency, and its petroleum division does not buy, export, or import oil. E. C. A. is only financing the dollar deficit of the European countries, and the petroleum division will finance the deficit of dollars for shipping oil from dollar sources to those countries. Nations which cannot pay for their imports will be reimbursed for dollars they spend for oil or E. C. A. will issue letters of commitment to banks or suppliers which will allow the banks to issue letters of credit to the suppliers and the suppliers to get paid for their shipments.

E. C. A. makes no presents to any individual importer or exporter. The importer pays for his shipment of oil from dollar sources in local exchange, and the E. C. A. together with the importing country will decide what should be done with this money in accordance with the foreign assistance act of the U. S. Congress. For example, an importer in France wants lubricants for $20,000 from the U. S. He has to pay the equivalent in French francs to an account which is under the joint control of E. C. A. and the French government and it will be disposed of in accordance with rules and regulations established by the U. S. Congress.

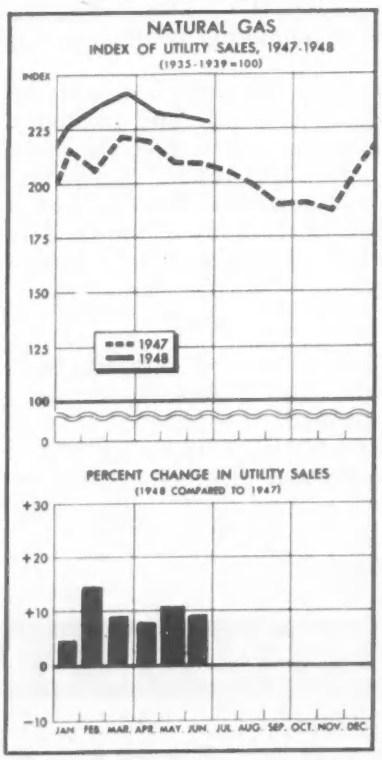
Under the E. C. A. program there are large requests for petroleum industry equipment. It is needed mostly for expanding refining capacity in E. C. A. countries in line with the increase in crude oil production expected in the Middle East. Especially is there a demand for equipment which only the U. S. has manufacturing facilities and technical ability to produce.

Total Natural Gas Sales Up 8.7 Percent

The natural gas industry, like the oil industry, is providing increased supplies for consumers, in spite of the difficulty of procuring pipe and other materials for expansion of facilities.

Total sales of natural gas by utilities were 2008 million therms in June, 1948, an increase of 8.7 percent over the sales of 1848 million therms in June, 1947, the American Gas Association reported. Natural gas sales stated in terms of mcf totaled 193.2 million in June, 1948, an increase of 8.3 percent over June, 1947. The association's June, 1948, index was 227.1, on the basis of 1935-1939 as 100.

In the 12-month period ended June 30, 1948, natural gas sales were up 10.4 percent over sales in the corresponding cumulative period ending in 1947, having increased to 26,822 million therms from 24,300 million. Stated in terms of mcf, natural gas sales totaled 2591 million in the current cumulative period ending June 30, 1948, equal to a rise of 10.6 percent when contrasted with the 12-month cumulative period ending June 30, 1947.



ADDS THE "Red Fleet"

Cementing Tools and Service Brought *Quickly* to Your Job

To their fleet of 90 cars and trucks, Weatherford has now added these 7 airplanes. They will be strategically based to best serve the Gulf Coast, Midcontinent and West Coast areas, as well as South American fields.

Weatherford Service Engineers are now within 3 hours of any producing area in the United States.

Hours, even days, will be saved in many instances where quick delivery of Weatherford Cementing Tools, or the presence of a Weatherford Engineer, is essential to the completion of a well.

WEATHERFORD

Spring Company

Manufacturers of Oil Well Specialties

MAIN PLANT: WEATHERFORD, TEXAS • TELEPHONES: LD 1 and 257

Looking Ahead

● CURRENT OUTPUT of oil country steel goods is at annual rate of 1.6 million tons. This is about equal to industry's domestic and foreign requirements, but pipe line output promises to fall considerably short of needs.

● FURTHER INFLATION is threatened by national defense program and aid to Europe. Considered good hedge against inflation, oil company stocks therefore continue to get high rating in stock market. Investors feel that if prices in general rise further, market value of oil reserves and of oil stocks will increase proportionally.

● CATCHING UP of supply of railway tank cars with demand is indicated by increasing deliveries in recent months and recent slowing down of new orders.

● UNDER A NEW direct reduction process, iron ore can be converted to practically pure, uncontaminated iron by using natural gas as fuel instead of coke. Iron produced by this method will run from $21 to $26 per ton compared with pig iron prices of $25 to $40. Dry ice can be produced as a by-product at a cost of only $15 a ton saleable at from $35 to $65 per ton.

● ELECTRODEPOSITION of tungsten alloys which retain their hardness even at elevated temperatures may be adapted to the deposition of wear-resistant coatings or working surfaces on such parts as pump liners, tool joints and subs, if experiments now under way can be extended to the relatively heavier oil field equipment without excessive handling costs.

● DEEPER DRILLING has caused heavier, more bulky equipment and increased physical strain on drilling crews. Current experiments and developments are expected to improve drilling equipment from standpoint of reducing physical effort of workers. These developments are aimed especially at lengthening the active working years of members of drilling crews, while seeking also to increase the life of drilling equipment.

● IMPROVED PRICES for liquefied petroleum gas are encouraging installation of much more equipment for its production at natural gasoline plants and refineries. But "bottled gas" scarcity is expected anyway next winter, because industries bid against farmers and other users for supply. Producers now obtain 7 cents a gallon on West Coast, 9 cents in East, compared with only 2 to 3 cents a year ago.

● GOAL IS LATE 1948 for report covering current nationwide survey of stripper well areas to determine quantity of oil recoverable by both primary and secondary production methods. Survey is joint project of Independent Petroleum Association of America, National Stripper Well Association, and Interstate Oil Compact Commission. Report will show number of producing and abandoned wells, productive acreage, production, and reserves of every district of U. S., in most cases by fields. State agencies are gathering information and some consultants are being employed.

● AN ELECTRONIC protective device, said to safeguard against mechanical overload, and now operating on motor-driven industrial applications, may offer a means for avoiding twistoffs of drill pipe while under automatic control drilling.

Lion Oil Company's Public Relations Program

A bird's-eye view of some of the materials used in the Lion public relations program.

THE OIL INDUSTRY'S national public relations effort now having been in operation for almost two years, an appraisal of results achieved and a review of methods employed is timely. Rather than a survey-type study, which would be difficult of analysis due to the lack of uniformity of types and sizes of companies involved, WORLD OIL presents a case-history report of a representative oil company's activities in cooperation with the national program. The company chosen for study was selected on the basis of its size (not too large and not too small), type of operation (well integrated), and its sphere of operation (clearly defined). The public relations activities of the Lion Oil Company are outstanding and are also illustrative of ways in which any oil company of any size can join in the industry's efforts to win better public understanding.

LION Oil Company's participation in the oil industry's public relations program has been a success, both for the company and for the program.

The importance of good public relations had not been ignored by the company prior to the inception of the industry-wide effort. Lion officials have sought for many years to have and to deserve good relations with employes, customers, stockholders, the general public, and particularly the residents of its domicile, El Dorado, Ark.

Chief executive officer of Lion Oil (and chemical) Company is Col. T. H. Barton, board chairman, and working with him as the other half of a close-hitched team which has functioned smoothly for 20 years is T. M. Martin, president. In their words, "The oil industry's national program and our participation in it have crystallized the things we have wished to accomplish in this sphere. The program has broadened our public relations scope and at the same time made more specific and more effective our efforts within that scope. It has given us many fine tools with which to work, and at the same time has helped us to devise new tools of our own. This program is working well for us."

Probably the keynote of Lion's success with the program is the unstinting time and effort given by its executive and key personnel. Colonel Barton is a member of the Public Relations Committee of the API board of directors. Jack Clarke, Colonel Barton's assistant, functions as a member of the Oil Industry Information Committee, the second echelon which actively plans and administers the program on the national level. T. M. Martin, Lion president, serves on the front lines as Arkansas state chairman in the Gulf-Southwest committee. C. R. Olson, advertising manager, has extended the cooperation of the company's advertising and publications, and other company executives have aided enthusiastically.

Lion's initial approach was to absorb fully the philosophy of the program's intents and aims, so that the company could participate in every phase of activity possible, and through every medium of expression. Its efforts have, accordingly, been creative rather than stereotyped, and numerous noteworthy public relations projects have grown out of the increased concentration on public relations brought about by working in the national endeavor.

"First, we analyzed the avenues open to us for telling our story and the industry's story," commented Jack Clarke, who is primarily charged with implementing public relations activities in the

company. "Our original investigation showed opportunity for use of literature and other printed material, for special stockholder messages, for advertising tie-in, for public addresses, for audio-visual presentations, for publicity, and for employe activities. We sought to chart our public relations course to take advantage of all these opportunities. Then we studied the materials made available through the industry's public relations program, and quickly adopted everything that fitted our pattern and method of doing business. We have developed various materials of our own as well as continuing to use materials produced through the facilities of the OIIC and the Fred Eldean Organization."

Opening Program

Lion moved vigorously into the program at the outset, with the following schedule of activity.

1. One thousand five-hundred posters, "Petroleum Promotes Progress," were distributed to service stations and bulk plants, via the sales channels of the company, with instructions for posting.
2. One thousand eight-hundred copies of "We've Got a Story," were distributed to employes via the pay-check route. The pamphlet, "Wanted: 140 Million Friends," was used at the executive level. This employe literature distribution has been repeated at frequent intervals, using, "Do You Know Bill Burns?," "Your Industry and Mine," and such company-produced pieces as "Facts About Lion Oil Company" and "Where Are We Going?," the latter a concise economic commentary by President Martin.
3. "How Deep Is a Well?" and the "Research" leaflet were distributed to 2200 royalty owners.
4. Nine thousand credit customers received, via monthly statements, "Most People Amazed at Number of Oil Companies," and the "Price" insert.
5. One hundred thousand copies of "Most People Amazed" were sent in varying quantities, via the division sales offices, to all service stations for direct-to-customer distribution. Numerous requests for additional quantities were received.
6. Postal-meter slugs "Petroleum Promotes Progress" have been in Lion's meters for over a year, turning out the slogan on approximately 50,000 pieces of mail each month.

Lion's marketing organization was alerted and briefed on the program's aims and fundamentals at the annual jobber meeting in 1947, and program material and ideas have continued to flow through the organization via the *Lion Oil News*, which is sent to all employes and which has a large circulation outside the company. *The Lion Oil Farm News*, a consumer publication slanted to farm audiences and having a national circulation, has also carried program materials, including recent publication of the entire "Efficiency Guide for Farm Machines."

Lion's advertising department tied in

T. M. Martin, left, Lion president, acting as Arkansas state chairman in the Gulf-Southwest committee, confers on action plans with Jack Clarke, O.I.I.C. member.

Educational literature is distributed to employes at the time-clock, as each shift leaves the plant.

Col. T. H. Barton, Lion board chairman, is in great demand as a speaker at events of all sorts, and rarely declines, throwing his personal prestige into the job of making friends for the oil industry.

generously. "Progress" slugs and streamers were inserted in regular publication schedules. Stand-out of advertising cooperation, however, was the inclusion of program continuity in the company's regular Sunday radio show, "Sunday Down South." This program, originating in Nashville and carried over a network of 21 Southern radio stations, enjoys a fabulous listening audience. Reliable surveys show listenership reaching as high as 22.8 in such points as Tupelo, Miss., and even in Grenada, Miss., where there is no local station, the Lion show has a rating of 16.4.

From the standpoint of another stellar Lion project, the timing of the national program was perfect. Production of a sound-color movie to portray the company's policies and products had been a pet study of the public relations-minded Lion officials, and the industry's program objectives helped crystallize this planning and to give direction to the film's theme. Titled "Revolution in the South," the film traces the evolution of oil production, refining and distribution in the Southern states, dramatizing the great part oil has played in bringing the South from the stark desolation following the Civil War to its present industrial stability.

A motion picture of this nature, skillfully produced and well edited, is a powerful public relations tool, but its effectiveness will be strictly governed by the skill with which it is used. Lion has attained "maximum performance" from this film.

Initially, a series of screenings were arranged so that all company employes and members of the marketing structure had the opportunity of previewing the film. A program was then begun to reach thought-leader groups throughout Lion's operating territory.

A special representative, Samuel White, a retired army colonel, was employed and trained to handle showings of the film and Jack Clarke's office became a booking agency, arranging a schedule of screenings well in advance. The special representative then "went on tour" and fulfilled the booking schedule, which ranged from Rotary and Lions Clubs to special student audiences in universities. Colonel White's routine was to precede each film showing with a brief commentary, based largely on the industry's program objectives.

For use primarily in developing bookings, Olson prepared a special folder describing the film. Current requests far exceed available prints, and the film's distribution long since ceased to be confined to Lion's operational area. Requests have been received from all over the country and from such remote points as Hawaii. Since December, 1947, showings of the film by Colonel White alone total 114, reaching audiences totalling 12,888 community leaders in Arkansas, Tennessee, and Mississippi.

Executives Cooperate

It was stated earlier that Lion's success in this program has been due in great measure to the personal contributions of time and energy made by the top executives. Nowhere has this been more true than in the availability of company officials to make public addresses on behalf of the industry. Much in demand as speakers before service clubs and industry groups, Lion executives rarely decline, and then only in cases of absolute inability to appear.

During the past six months, Colonel Barton has appeared before such groups

Jack Clarke dispatches a print of "Revolution in the South," Lion's public relations movie, to the remotest point from which requests have been received to date: Honolulu.

as the Dallas Petroleum Engineers' Club, The AIME, the Arkansas State Conference of High School Honorary Societies, the Arkansas Livestock Association, and numerous other gatherings. Martin has addressed the Little Rock Chamber of Commerce, the Arkansas Utilities Association and others. Dr. Frank J. Soday, director of research, covered the complete roster of El Dorado clubs, appearing before the Kiwanis, Rotary, Lions, Business & Professional Women's Club, and the Home Demonstration Club. Jack Clarke has made countless public relations presentations before groups making conducted tours of the company's refinery and chemical plant, and numerous appearances at schools and universities.

Lion has always sought cordial relations with stockholders and employes. Current feature of the stockholder-relations program is the Petroleum and Chemical Information Series, a window-type enclosure for dividend checks developed by Clarke, each of which comprises a discussion of some phase of the company's operation. Stressing progress in every aspect, this series also bears the "progress" slogan.

Employe relations follow the pattern of utilizing every possible medium of keeping workers aware of the company's progress and of their stake in it, but sharply avoid any tinge of paternalism or interference. Basic unit of this program is the "Barton Club," and there is one for each division of the company. These are autonomous employe organizations, operated and controlled by elected officers from the membership, with the principal activities being social and recreational. The company's policy is hands-off the Barton Clubs' management, and is active only in financial assistance and in furnishing of facilities.

Another feature of Lion's public relations operation is the careful attention given to detail, and the determination not to miss any bets, small or large. In distribution of employe literature, for example, when folders are distributed via time-clock cards, care is taken to make the distribution when each shift is punching "Out" rather than "In," thus giving the literature entrance to employes' homes, for more leisurely scrutiny and for possible secondary audiences. The company's support of the Independent Petroleum Association of America entitles it to nominate numerous associate members. Rather than neglecting this privilege, or being careless with such nominations, the company carefully selects the nominees from investment and banking circles, professors and similar thought-leaders.

When the compilation of industry information titled, "Questions and Answers" was recently distributed to OIIC members, Jack Clarke's copy didn't have time to cool off on his desk before he had persuaded the El Dorado Evening Times to institute a daily editorial feature column titled, "Questions and Answers About the Oil Industry," using the program material verbatim. He also was successful in getting the material presented in commentary form over radio stations KELD and KARK, and expects shortly to expand the newspaper column to other Arkansas papers.

When the industry program was formulated, every effort was made to develop a program that would harness every available medium for better informing the public. This objective, for practical purposes, is reached in the Lion operation.

Refinery piping for every need... from one complete line

No matter how varied your needs, the complete Crane line has much to offer. **Take this Treating and Sweetening Process Piping, for example.** You can see at a glance that Crane can supply every piping item in the system—valves, fittings, accessories, pipe and fabricated piping . . . in steel, iron, brass and corrosion-resistant alloys.

To standardize on this **Single Source of Supply** is to simplify all piping procedures, from design to erection to maintenance. One order to Crane covers everything you need. Putting **Complete Responsibility** on Crane for piping equipment delivered to the job helps you to get the best possible installations, without needless delays. The **Uniform High Quality** of every item from the broad Crane line assures efficient, dependable piping performance throughout processing systems.

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SOURCE OF SUPPLY
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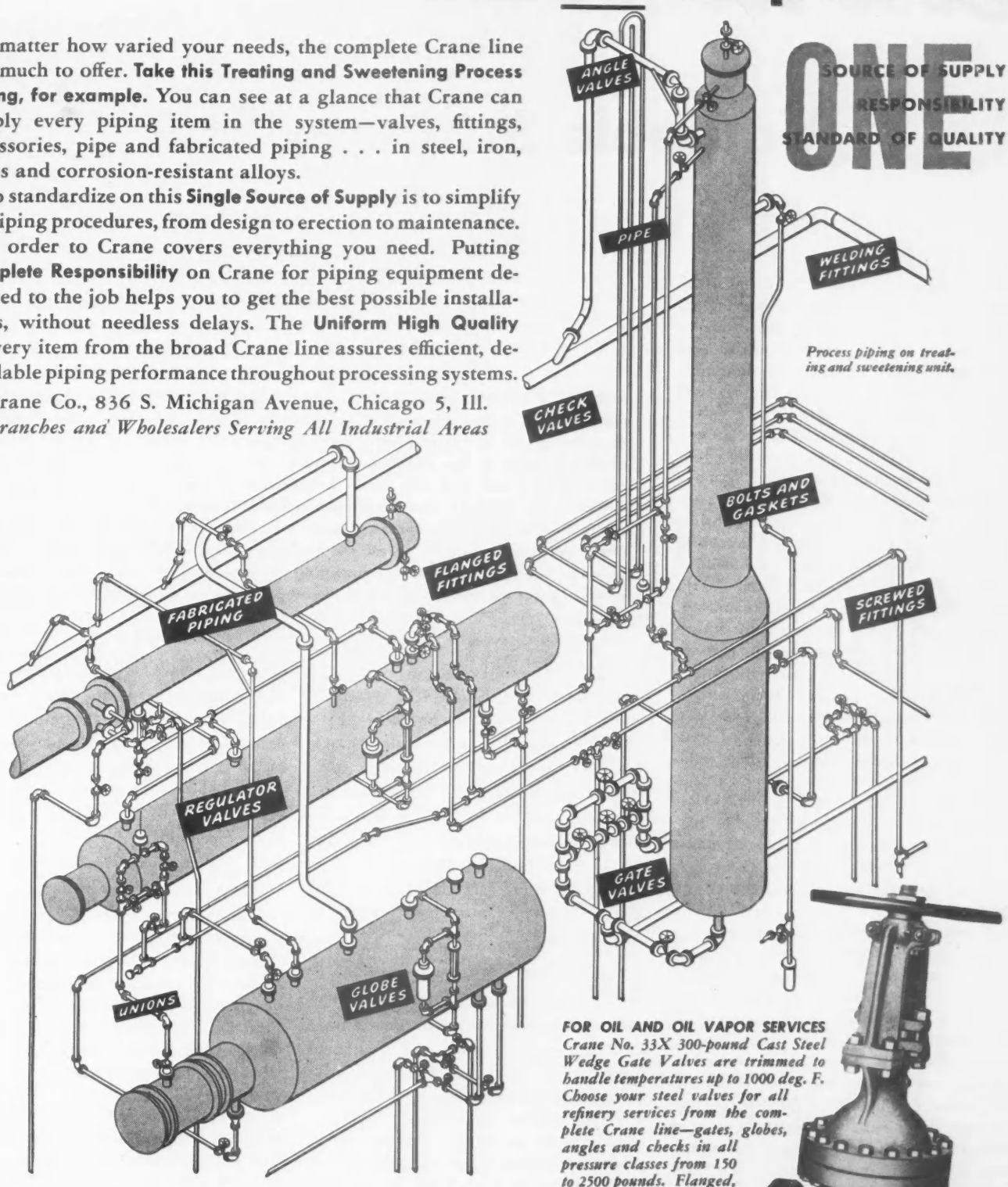

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Cost Accounting—

Valuable Business Tool

By W. F. JONES

ACCURATE COST ACCOUNTING is an essential tool of the drilling contracting company as well as the independent oil company or operator, as it definitely helps to assure profits and to eliminate losses on operations. With accurate cost records available, there is less likelihood of losses being repeated because the records reveal where and why such losses have occurred. Steps may then be taken to eliminate them. There is also less likelihood that bids obviously too low will be made. While there is always the hazard of being too optimistic about drilling time and the days required for a rig on a well, the cost records will at least show costs per day of operating the equipment, preventing underbidding in this respect. Use of punched cards for accounting and statistical purposes will permit rapid and accurate results.

BUSINESS in general, and the drilling contracting business in particular, possesses a tool which, all too often, is not used to the best possible advantage. This is cost accounting. One definition of cost accounting might be "the recording, analyzing, summarizing and interpreting of figures representing the money expended and indebtedness incurred in carrying on business operations." An accounting system may vary from the very simplest of records to numerous subsidiary ledgers and other books of account, depending upon the size of the business.

Regardless of size, each firm should maintain a system of cost accounting. Cost records should be a guide for future operations. Naturally, unless cost records and their interpretations are utilized, it is a waste of time to keep them. If management learns from the records of a business that it is being operated at a loss, yet fails to take steps to remedy the situation, the best cost system in the world will be of no use. Contrariwise, should the facts presented by the records be faced and steps taken to eliminate losses and turn them in to profits, cost accounting has again justified its existence.

Proper management of a business requires proper records, correctly maintained, from which the necessary operating statements can be produced with accuracy and rapidity. Such guides make it possible to determine whether any elements of cost are out of line; whether sales prices are too low; how operating personnel are handling their respective departments; relative performances of different types of equipment; comparison of various operating methods, and so on. Such records should be the basis of preparation of bids, the setting of sales prices, etc.

How can a cost accounting system be established? In its simplest form, a payroll register with distribution of labor charges to various jobs or expense accounts, plus a voucher record with an analysis of the invoices entered therein and a segregation of items not only by contracts or jobs, but also a grouping by different types of expenses, would undoubtedly prove adequate. The goal is to determine how much it has cost to do business; and, on that basis, how much it is likely to cost in the future.

At this point I should like to call attention to two books published by the American Association of Oil Well Drilling Contractors: (1) "Manual of Uniform Accounting Practices for the Oil Well Drilling Contractor," and (2) "Costing Guide."

Other Breakdowns

While only seven accounts are shown under "Costs and Expenses for Contract Drilling," any number of additional breakdowns may be used to meet individual requirements. Generally speaking, a small number of accounts make it easier for an accounting department to produce the reports required of it. However, it does not always follow that only a few accounts are needed to guide the management of a company. It is, therefore, highly desirable for management and the accounting department to fully discuss the needs of a business, in order that all necessary (but no unnecessary) reports, statistics and records be established and maintained.

Several methods of maintaining accounting records are in use: (1) Manually, with bookkeeping machines; (2) with punched cards and tabulating machines; or (3) various combinations of these. Generally speaking, the volume of business and the speed with which the completed reports are needed will govern the type of installation best suited to the needs of a company.

Manual operations usually are slower and less accurate than machines. Where the volume is great enough to justify the use of punched cards and tabulating machines, a greater variety of statistics and reports of value to management can be produced at a lower unit cost and in less time than by other methods. The cost of the equipment is too great, however, to justify its use except by the larger companies. To take care of the smaller companies there are contract services available offering the benefit of punched card accounting with consequent savings in costs, greater accuracy and speed, yet involving no installation of equipment by the client.

In preparing estimates of costs for bids on new work; a form should be used, listing each item so as to prevent overlooking some very vital element of cost. A sample of such a form is shown in Figure 1.

Such a form should include indirect as well as direct costs. In addition to labor,

supervision, supplies, maintenance and repairs, bits, transportation, mud and chemicals, coring, insurance, etc., depreciation on the rig and on drill pipe should be included, as well as a prorata share of field and general office overhead. After totaling all costs, a margin of estimated profit should be added, and the total of estimated costs plus profits thus becomes the price of the bid.

It will be noticed that Figure 1 includes two forms: (a) which breaks down cost of moving in, rigging up and moving out; and (b) which covers elements of cost entering into actual drilling and operating expenses. Principal reason for the use of two forms is the fact that some companies ask that the contractor submit his bid showing rigging-up as a flat figure and the actual drilling bid given on a footage basis.

To yield the best results, the cost records should be set up in such a manner as to reflect the costs of operating each individual rig.

Accumulating Cost Figures

To illustrate how cost figures may be accumulated and used in preparing estimates for bids, Figure 2 is shown. From these figures it will be noted the operating costs of rig No. 2 are $595.00 per day, while the daily costs of rig No. 5 are $905.00. From available data, from past experience, and from the operator's requirements, an estimate of the total number of days required to drill and complete the wells is prepared, as shown in Figure 3. Combining the daily rig costs, as shown in Figure 2, with the total number of days shown in Figure 3, and adding other elements of cost and a margin for profit, the results shown in Figure 4 are reached.

Assuming the figures of $8.47 and $19.79 per foot to be in order, cost records of the two jobs are maintained, and upon completion of the work a comparison of the actual costs with the estimates is made, as shown in Figure 5.

An analysis of Figure 5 indicates a saving of a day's drilling time on Well "A," and fewer bits used than estimated, resulting in an increased profit of $695. On Well "B" it is found that, due to inclement weather, two days more than estimated were required to move in and rig up; and due to loss of circulation three more days were lost. These items, plus others which arose, increased the costs $19,525 above the estimate, and reduced anticipated profits from $32,975 to $13,450 under this contract.

Alert management will, of course, desire to know not only how much was made or lost on these two contracts, but will wish to take steps to avoid repetition of any unfavorable incidents in future operations. For example, possibly

Part A

Elements of Cost Entering Into "Moving-In, Rigging-Up, Dismantling and Moving-Out":				
Trucking—In and Out (Include Crane Service)				
Welding				
Woodwork—Ditch, Engine House, Pump House, Racks, Flooring				
Electrical Work—Wiring, Rig Lights, Pump Lights, Connecting Generator				
Derrick or Mast:				
Foundation Cost				
Cellar (cements)				
Derrick Rental				
Erection and Dismantling				
Total Derrick				
Crown Block—Erection and Dismantling				
Roads, Cellar (exacvating), Sump, etc.				
Water Lines and Fuel Lines				
Mud Tanks and Water Pump				
Mud Tanks				
Rat Hole				
Pipe Racks, Deadmen, etc.				
Boiler Installation				
Rigging-Up Supplies, Including Valves and Fittings				
	Per Day			
Labor—Direct (incl. Comp. Ins., Payroll Taxes, etc.)				
Crew Expenses or Mileage Allowance				
Supervision—Direct (incl. Comp. Ins., Payroll Taxes, etc.)				
Auto Expense—Direct				
Total Direct Labor and Supervision, per Day				
General Administration Expenses— (Including a pro-rata share against this rig of salaries, Office rent, field office and yard expense, telephone expense, insurance, property taxes and all other indirect expenses				
Total Labor, Supervision and Administrative Expenses, per Day				
Rigging-Up—Labor, Supervision and Administrative Expense, No. of Days				
Dismantling—Labor, Supervision and Administrative Expense, No. of Days				
Total, No. of Days		@		
Total Costs, Ready to Spud:				
Add Profit				
Total Sale Price				

Part B

Elements of Cost Entering Into: "Daily Rig Operating Expenses:"				
Direct Labor, Incl. Comp. Ins., Payroll Taxes, etc.				
Direct Supervision, Incl. Comp. Ins., Payroll Taxes, etc.				
Direct Auto Expenses				
Crew Expense or Mileage Allowance				
Rig Operating Supplies—				
Maintenance and Repairs:				
Wire Lines				
Chain and Belts				
Lubricants				
Welding				
Surveys				
Misc., Hauling (not including in and out Rig)				
Packing, Rope, etc.				
Valves and Fittings				
Pump Parts				
Hand Tools				
Other Expendable Items				
Drilling Equipment Repairs (**not** including major overhauls)				
Major Repairs and Overhaul Costs				
Drill Pipe Maintenence Costs—(Includes everything from Kelly to the Top of the Bit, in the Drilling String)				
Miscellaneous				
Administrative Expense: (Includes pro-rate share, against field office and this Rig, of salaries, office rent, field office and yard expense, telephone expense, insurance, property taxes, indirect expenses not included in Direct Supervision above, per Day				
Depreciation—Drilling Equipment (Incl. Mast, Drill Collars, Drill Pipe and Tool Joints)				
Daily Sub-Total				
Fuel	Daily			
	Volume or Quantity	Cost		
Natural Gas				
Butane				
Diesel Oil				
Fuel Oil				
Bits and Reamers				
Core Bits and Service Charge				
Mud and Chemicals				
Power and Light				
Water				
Equipment and Tool Rental (Not Company owned)				
Mud Disposal				
Contingencies				
Blow-Out Prevention				
Total Daily Operating Costs:				
Add Profit				
Total Sale Price, per Day				

FIGURE 1. Sample forms which may be used by the drilling contractor to prevent his overlooking some very important element of cost in preparation of bids. Necessarily somewhat voluminous because the author has included numerous items that might not be encountered in every drilling job, the forms are designed to break the bid into two parts: (a) moving in, rigging up, and moving out, and (b) daily operating costs with which the drilling can be bid on a footage or daily basis.

the derrickmen should attend the drilling mud control courses sponsored by the American Association of Oil Well Drilling Contractors; perhaps such instruction might enable them to avoid loss of circulation in future wells in the same area. Or, if loss of circulation is to be a constant hazard, possibly the contract terms could be amended to include a top limit for mud and chemicals.

It is believed that some contractors fail to include depreciation as a part of their costs in preparing bids. This practice will result in wearing out equipment and then having no funds with which to replace it.

Since speed and accuracy are essential to good cost accounting, management looks with favor on methods or equipment which will produce required results more promptly. When such methods will also reduce costs, executives would be derelict in their duties if they failed to investigate. For these reasons an outline of benefits to be derived through the use of the punched card system in cost accounting is presented.

It is recognized that punched card equipment is expensive and that its use requires an appropriate volume of business to justify the cost. However, there is available a contract service offering the use of punched card systems and equipment to clients who, individually, would not have sufficient volume to justify such equipment, but collectively do provide enough work to merit such an installation. Therefore, the speed and accuracy of the punched cards and tabulating machines, together with the savings in costs in preparing cost accounting records, are made available to the smaller firm as well as to the larger.

Punched cards are just that—cards of a standard size in which holes have been punched to record certain basic information, either alphabetical or numerical. These cards are then sorted into any desired order, and fed through a tabulating machine to produce the printed statements required. There are two types of tabulating equipment available: Remington-Rand, which utilizes mechanical operation from round holes in the cards; and International Business Machines, which operates from electrical contacts through oblong holes.

For handling payrolls, it is possible to punch "hours worked" into cards for each employee, together with his occupation, Social Security number, the account to which it is wished to charge his wages, and such other information as may be desired; then, feeding these cards into an automatic multiplying machine together with a basic rate-per-hour card, gross earnings per man can be produced. Cards providing for the necessary deductions—Withholding tax, Federal Old Age Benefits, Unemployment Insurance, bond deductions, etc.—which have been previously prepared, are sorted into proper order and fed, along with the gross earnings cards, into the tabulating machine to produce the printed payroll checks themselves, together with a statement on check stub showing gross earnings, all deductions, and net amount payable. It is also possible to indicate on the stub each pay period the total earnings to date, total taxes withheld to date, and information of a similar nature.

From these same cards the distribution of labor costs, Social Security, and withholding tax returns may be prepared, together with the payroll itself. If desired, the duplicate copy of the payroll checks can become the check register, with totals provided automatically by the tabulating machine.

In the handling of invoices payable, a card is punched for each invoice, with the name of the vendor, the amount, a brief description of the material purchased, the date, the account to which it is to be charged, and such other pertinent information as may be required. Then monthly, or as frequently as it is desired to pay invoices, these cards are sorted by vendors, and can then be put through the tabulating machine to produce remittance statements indicating gross amount, the discount, and net amount payable, together with the checks themselves. The duplicates of the checks can be used as the check register, with totals automatically provided by the machine. Another sorting of the cards by account numbers will then produce the distribu-

About the Author

W. F. (FRANK) JONES, secretary of the California Chapter of American Association of Oil Well Drilling Contractors, has had a wide experience in the oil industry. Shortly after being discharged from the Army in 1919, he went to work for Standard Oil Company of California. In 1922 he went with Cyrus Bell when the latter started in the drilling contracting business, remaining in that work until June, 1933. At that time he joined Middle Dome Corporation, a unit plan to handle Middle Dome Field of Kettleman Hills. In 1937 he joined California Lands, Inc., as manager of oil and gas operations, which position he held until 1939. During the recent war he went into heavy construction work connected with the war effort. Between 1945 and 1947 he engaged in the drilling contracting business. In recent years he has specialized in cost accounting and general accounting practice as it pertains to the drilling contracting business.

	Well "A" 5,000 Ft. Rig No. 2	Well "B" 10 000 Ft. Rig No. 5
Labor and Supervision	$225.00	$275.00
Maintenance and Repairs	60.00	100.00
Supplies	30.00	50.00
Fuel	60.00	100.00
Insurance	20.00	30.00
Depreciation—Rig	75.00	150.00
Depreciation—D.P.	75.00	150.00
Overhead	50.00	50.00
Total Operating Costs, per Day	$595.00	$905.00

FIGURE 2. Typical example of how daily operating cost data may be accumulated for various size rigs when used on wells of various depths. Average total operating costs for each size rig are used in arriving at bid figure.

	Location for Well "A" Rig No. 2	Location for Well "B" Rig No. 5
Average number of Days to move in, Rig Up, Dismantle and move Out	6	12
Average Day's Drilling time	26	93
No. of Days required for Coring	2	6
No. Days required for Elec. Logs	1	3
No. Days required for Tests	1	3
No. Days required for Cementing and Standing Cemented	3	6
No. of Days required to complete	1	2
Total Estimated Days	40	125

FIGURE 3. From the contractor's past experience in an area, the requirements of the oil company, and other factors, an estimate of the total number of days required to drill and complete the two wells is prepared in the manner shown above.

	Well "A"	Well "B"
Operating Costs:		
40 Days at $595	$ 23,800	.....
125 Days at $905	.....	$113,125
Bits	4,000	18,750
Coring	1,000	3,000
Mud and Chemicals	500	5,000
Transportation in and out	3,000	10,000
Miscellaneous	3,000	15,000
Total Est. Costs	35,300	164,875
Add Profit	7,060	32,975
	42,360	197,850
Bid Figures, per Ft.	8.47	19.79

FIGURE 4. By combining daily rig cost data shown in Figure 2 with estimated total number of days shown in Figure 3 and adding other elements of cost, plus profit margin, the final bid figures on a footage basis are determined.

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tion of the purchases to the various expense or other accounts, and these, in turn, may be grouped by the various contracts involved. Figure 8 shows typical example of Accounts Payable Register and Accounts Payable distribution by well—by account records made possible through use of punched cards. By this means it is possible to determine not only the total costs for the drilling of each well, but also the make-up of these costs.

From these same cards, considerable information may be obtained. For example, the number and kind of bits used; the number and make of V-belts purchased; the feet of chain bought, etc. Comparisons can be made of the service given by different makes.

With regard to physical assets, punched cards prepared for these can yield the monthly depreciation write-off; the date and amount of original purchase; fully depreciated items; and a rapid means of determining profit or loss when selling or otherwise disposing of equipment. Sorting of these cards can disclose the quantity of any particular item, by location, size, etc. When desired, these cards can also become the equipment ledger and would be maintained by adding cards for all acquisitions of equipment and by removing cards covering items disposed of.

Operating Statements

Operating statements can also be produced by means of punched cards. With cards representing journal entries, such expenses as insurance, taxes, and amortization of prepaid items may be taken into consideration. Breakdowns between direct and indirect expenses, operating and non-operating, field and other overhead can be easily made. Likewise, comparisons between periods are easily established, either by months, quarters or years.

So long as all the required information is punched into cards, the general ledger itself can likewise be posted and maintained on the tabulating machines. Statements of profit and loss and balance sheets—comparative or otherwise—can thus be prepared. Ordinarily about six clear carbon copies can be made on the machines, and if more copies are required they can be made from either a stencil cut by the tabulator or from a master "Ditto" copy.

While ordinarily accounts are handled on a monthly basis, this need not be done where punched cards are used. If desired, financial and operating reports may be prepared daily, weekly or semi-monthly.

Since the electric sorting machines handle about 400 cards per minute on each run, it can be readily seen that the re-arranging of cards to produce different results does not require much time. The tabulating machines themselves will print about 100 lines of printing per minute. Therefore, once the basic information is punched into the cards, no great amount of time is required to sort them into proper order and to tabulate them.

For those contractors owning production, the punched card system offers considerable saving in preparation of royalty statements and royalty checks; production, storage and sales figures; operating expense figures, both in total and per barrel; depletion statements, etc.

For petroleum engineers, it is possible to effect considerable saving of time and effort in the preparation of production decline curves, estimates of reserves, depletion factors, etc., by use of punched cards and correlative equipment. For

	WELL "A" RIG NO. 2			WELL "B" RIG NO. 5		
	Estimate	Actual	Difference	Estimate	Actual	Difference
Total Days	40	39	—1	125	130	+5
Operating Costs	$23,800	$23,205	595	$113,125	$117,650	$4,525
Bits	4,000	3,900	100	18,750	18,750	.....
Coring	1,000	1,000	....	3,000	3,000	.....
Mud and Chemicals	500	500	....	5,000	10,000	5,000
Transportation	3,000	3,000	....	10,000	15,000	5,000
Miscellaneous	3,000	3,000	....	15,000	20,000	5,000
Total	35,300	34,605	—695	164,875	184,400	+19,525
Contract Price	.....	42,360	....	.....	197,850	.....
Profit	.....	7,755	....	.....	13,450	.....

FIGURE 5. After the wells have been drilled and actual costs determined, an analysis of the jobs should be made. By comparing estimated figures with actual costs, the profit or loss on each job can be determined as shown above, and if there is a loss, the reason for it can be found and steps taken to prevent repetition in future operations.

Payroll Register

Employee No.	OCC Code	Employee Name	Rate	Regular Hours	Prem. Hours	Total Hours	Regular Earn.	Premium Earn.	Total Earn.	S.U.I.	F.O.A.B.	Withhold Tax	Misc. Ded.	Check No.	Net Amount
1001	222	John K. Andersen	1.75	40.0	10.0	50.0	70.00	26.25	96.25	.96	.96	8.50	10.00	1234	75.83
1002	222	Kenneth L. Andersen	1 75	40.0		40.0	70.00		70.00	.70	.70	12.00	5.50	1235	51.10
1003	223	Gerald M. Avery	2.00	40.0	10.0	50.0	80.00	30.00	110.00	1.10	1.10	18.50		1236	89.30
1004	223	Nathan M. Axel	2.00	40.0	5.0	45.0	80.00	15.00	95.00	.95	.95	8.50		1237	84.60
1005	224	Robert L. Beam	1.75	40.0		40.0	70.00		70.00	.70	.70	12.00	9.85	1238	46.75
1006	224	Joseph T. Bender	1.75	40.0		40.0	70.00		70.00	.70	.70	14.00	10.00	1239	44.60
1007	224	Gerome D. Bixel	1.75	40.0	10.0	50.0	70.00	26.25	96.25	.96	.96	15.50	6.50	1240	72.33
1008	225	Paul H. Bott	2.00	40.0		40.0	80.00		80.00	.80	.80	12.00	5.00	1241	61.40
1009	225	Laverne Cantrell	2.00	40.0	5.0	45.0	80.00	15.00	95.00	.95	.95	8.50	2.50	1242	82.10
1010	226	Edward J. Capp	1.75	40.0		40.0	70.00		70.00	.70	.70	14.00	4.85	1243	49.75
						440.0 T	740.00 T	112.50 T	852.50 T	8.52 T	8.52	123.50 T	54.20 T		657.76 T

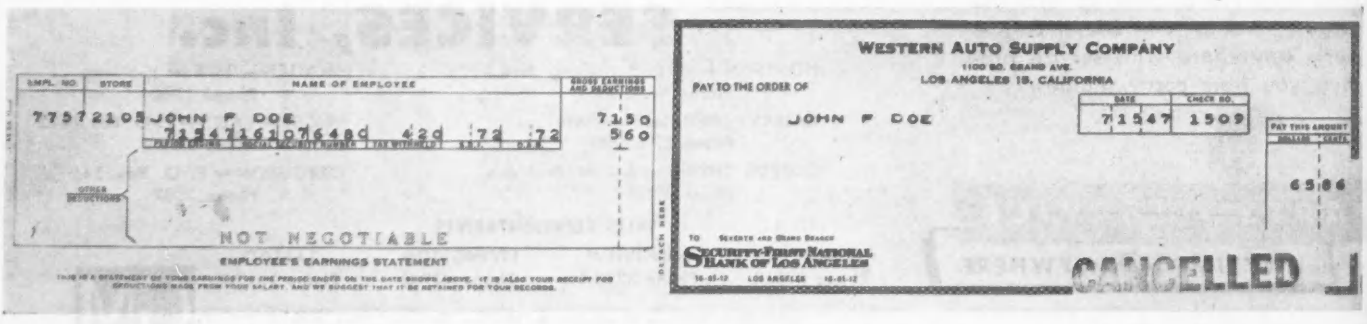
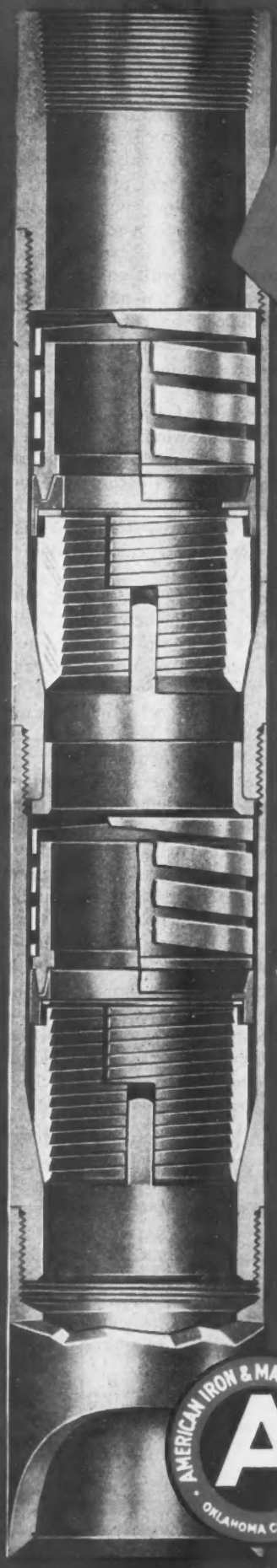


FIGURE 6. Sample payroll register and completely printed check as printed by the tabulating machine. Note that check stub includes breakdown of deductions for employe's records. Totals of columns of payroll register may be produced for any period and these totals then employed for quarterly and annual tax returns of company.



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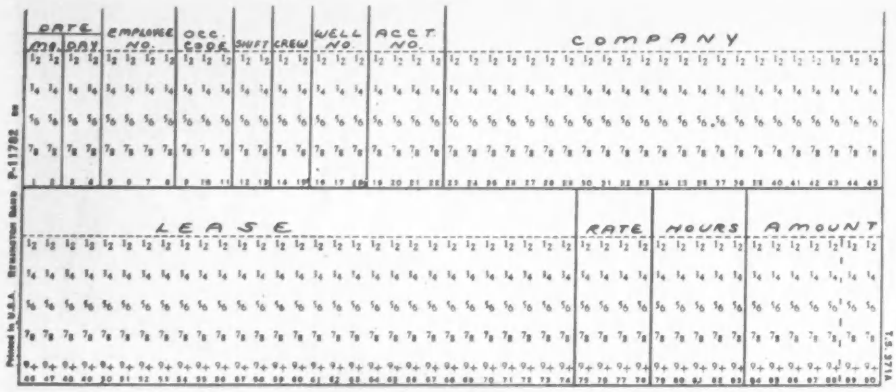

correlation purposes, when the depths of certain prevalent marker formations are punched into cards, as each well is drilled, a tabulation thereof can later be produced whenever desired.

Warehouse and other inventory records can be most advantageously maintained on punched cards, providing records of withdrawals from stores, additions, and current inventories, either by quantities or by values.

Analyses of operating expenses of trucks, cars, etc., can be handled very conveniently with punched cards. Costs per mile, per ton mile, per hour, or by vehicle can be readily obtained. Comparisons of different types of fuel for similar equipment can likewise be secured easily.

Records of leases acquired or lands purchased, when set up on punched cards, make it easy to meet rental due dates, pay taxes before delinquency, and at all times indicate the costs of any particular parcel when it is disposed of, thus permitting calculation of profit or loss.

Investments in securities, when established on punched cards, will yield a variety of information when needed. Not only the cost of any particular security, but its date of acquisition, dividend dates and rate, and all other pertinent information should be shown on the cards. Then, when the question of capital gains or losses arises, the answer can be quickly determined by sorting out the proper card.

Invoices to customers may be prepared, quickly and accurately, from punched cards. Cards should be made for the various factors involved, such as footage, coring, and other items for which the customer is to be billed, together with the items for which duplicate vendors' invoices are to be furnished. Properly sorted and fed into the tabulator, these cards will automatically produce detailed invoices, accurately totaled.

Payroll Distribution Register

Date	Employee No.	Shift	Company	Lease	Crew	Well No.	Acct. No.	Hours	Amount
4-13	105	1	Blank Oil Co.	Rosecrans	1	48	120	8.0	16 00
4-13	107	1	Blank Oil Co.	Rosecrans	2	48	120	8.0	16.00
4-13	130	1	Blank Oil Co.	Rosecrans	3	48	120	8.0	16 00
4-13	132	1	Blank Oil Co.	Rosecrans	4	48	120	8.0	14.00
4-13	134	1	Blank Oil Co.	Rosecrans	5	48	120	8.0	14.00
								40.0 T	76.00 T
4-13	141	2	Blank Oil Co.	Rosecrans	1	48	120	8.0	16.00
4-13	142	2	Blank Oil Co.	Rosecrans	2	48	120	8.0	16.00
4-13	143	2	Blank Oil Co.	Rosecrans	3	48	120	8.0	16.00
4-13	144	2	Blank Oil Co.	Rosecrans	4	48	120	8.0	14.00
4-13	146	2	Blank Oil Co.	Rosecrans	5	48	120	10.0	17.50
								42.0 T	79.50 T
4-13	210	3	Blank Oil Co.	Rosecrans	1	48	120	8.0	16.00
4-13	212	3	Blank Oil Co.	Rosecrans	2	48	120	8.0	16.00
4-13	213	3	Blank Oil Co.	Rosecrans	3	48	120	8.0	16.00
4-13	215	3	Blank Oil Co.	Rosecrans	4	48	120	8.0	16.00
4-13	216	3	Blank Oil Co.	Rosecrans	5	48	120	8.0	16.00
								40.0 T	80.00 T
4-13	137	1	Regular Oil Co.	Johnson	1	2	112	8.0	20.00
4-13	138	1	Regular Oil Co.	Johnson	2	2	112	8.0	16.00
4-13	139	1	Regular Oil Co.	Johnson	3	2	112	8.0	16.00
4-13	140	1	Regular Oil Co.	Johnson	4	2	112	8.0	16.00
								32.0 T	68.00 T
4-13	148	2	Regular Oil Co.	Johnson	1	2	112	8.0	16.00
4-13	149	2	Regular Oil Co.	Johnson	2	2	112	8.0	16.00
4-13	150	2	Regular Oil Co.	Johnson	3	2	112	8.0	16.00
4-13	151	2	Regular Oil Co.	Johnson	4	2	112	8.0	16.00
4-13	152	2	Regular Oil Co.	Johnson	5	2	112	8.0	16.00
								40.0 T	80.00 T
								194.0 GT	383.50 GT

FIGURE 7. Sample punched card and payroll distribution ledger sheet modified to illustrate how the system may be used in distributing labor costs to various wells or leases, with subtotals and grand totals being available whenever needed.

Accounts Payable Distribution by Well—by Account

Invoice No.	Acct. No.	Lease	Well No.	Amount
3826	92 5	Johnson	2	175.00
3210	9215	Johnson	2	350.00
				525.00 T
5920	92 8	Mission	8-1	2,050.00
				2,050.00 T
3826	92 1	Rosecrans	48	250.00
3826	92 5	Rosecrans	48	25.00
3210	92 7	Rosecrans	48	275.00
				550.00 T
				3,125.00 GT

Accounts Payable Register

Date	Vendor No.	Vendor Name	Invoice No.	Account No.	Company Name	Lease	Well No.	Amount
4-15	1234	Regional Supply Co.	3826	92 1	Blank Oil Co.	Rosecrans	48	250.00
4-15	1234	Regional Supply Co.	3826	92 5	Blank Oil Co.	Rosecrans	48	25.00
4-15	1234	Regional Supply Co.	3826	92 5	Regular Oil Co.	Johnson	2	175.00
								450.00 T
4-15	2987	Adams and Co.	5920	92 8	Regular Oil Co.	Mission	8-1	2,050,00
								2,050.00 T
4-15	1685	Ready Tool Works	3210	9215	Regular Oil Co.	Johnson	2	350.00
4-15	1685	Ready Tool Works	3210	92 7	Blank Oil Co.	Rosecrans	48	275.00
								625.00 T
								3,125.00 GT

FIGURE 8. Sample records made up to show how Accounts Payable register and Accounts Payable Distribution by Well—by Account data may be developed with use of punched card system. Electric sorting machines handle about 400 cards per minute on each run and tabulating machines print about 100 lines per minute. It is easily seen, therefore, that once basic information is punched into cards, no great amount of time is required to sort and tabulate card data.

Time and Competition

will make Oil Plentiful

By MAX W. BALL
Director, Oil and Gas Division, Department of the Interior

PREDICTIONS THAT oil never again will be abundant discount vigor of petroleum industry and underrate driving force of competition.

There is nothing in the petroleum situation that time and competitive forces will not cure. Present vigorous drilling will provide a material increase in crude production during next few months. If submerged lands are developed, only a few years may be required for production to catch up with increasing demand.

This article is from an address at the API Marketing Division, Atlantic City.

IN OUR concern with the problems of the next year or two, we sometimes forget to look farther ahead. If we would keep our perspective, we should pause now and then to gather confidence from the further prospect.

To me the long look is both hopeful and inspiring. I envision a greater oil industry, domestic and overseas, than we have ever had or dreamed of. I envision for the public a more abundant supply of better petroleum products at lower relative costs than it has ever known.

In what I have to say I am assuming no shooting war and no closer approach to it than our present state. How sound this assumption may be only time can tell. I must rest on it until those whose business it is to advise on such matters conclude that a shooting war is probable or inevitable. If war comes, all that I say, and all that any of us may say, will go out the window, and we will face the new emergency steadfastly as we faced the last one.

Pessimism vs. Optimism

I have said that to me the long look, for the petroleum industry and for the petroleum consuming public, is both hopeful and inspiring. Now and then recently I have heard statements to the contrary. I have heard a few men in the industry predict that never again will petroleum supply be abundant, that world demand will grow too fast for even a world-wide industry to satisfy.

Such predictions ignore economic history, discount the vigor and enterprise of the petroleum industry, and underrate the driving force of competition. Those who make them, it seems to me, are crying in their champagne. I see nothing wrong in the petroleum situation that time and the normal operation of competitive forces will not cure, if the normal competitive forces are permitted to operate.

Of course, there will be a great increase in world demand for petroleum products in the years ahead. Increased oil consumption is a necessary component of a rising standard of living, and who is so pessimistic as to doubt that the standard of living of the non-Russian world, and perhaps of the Russian world as well, will rise more rapidly in the future than in the past. Much of the present world unrest is caused by insistent desire for higher standards—standards which many of the countries have never had and to which a generation ago they scarcely aspired. These demands for better living will be satisfied, not all at once, but more rapidly perhaps than now seems possible.

Their satisfaction will involve, and to a large extent depend on, increased per capita consumption of petroleum products. There is no better index, no more essential ingredient of a higher standard of living, or a more tangible expression of it. From what I am told by those who have talked with the everyday folks of Europe, Asia, Africa, and Latin America, the dream and aspiration of most of them is to have an automobile, "if not for myself, then for my children."

They aspire to other things as well: adequate food, better and more varied clothing, more and better housing, telephones and radios and washing machines and electric refrigerators, and more of the luxuries that we have come to regard as necessities. These things call for raising greater crops for human consumption with less consumed by draft animals, and hence for more mechanized farming; for more factories; for more ample transportation; for increased mechanization and industrialization all along the line.

These dreams and aspirations call for greatly increased oil consumption, and such mass dreams and aspirations have a habit of coming true.

Consumption of petroleum products per capita in the U. S. in 1900 was 36 gallons a year. By 1947 it rose to 580 gallons a year; a gain of 1500 percent in 47 years, or 32 percent a year. Before World War II, in 1938, world average per capita consumption was 37 gallons per year. The world in 1938, in other words, stood almost exactly where the U. S. stood in 1900. If, in 20 years from 1938, world per capita consumption should increase by 32 percent a year, it would multiply by 6½ by 1958. Can we doubt that, with the U. S. showing the way, it will come close to tripling, and perhaps multiply by three or four?

I suspect that time will prove most of our world demand forecasts, high as they may now seem, to have been altogether too low. Does this spell discouragement? On the contrary, it spells opportunity.

Limitations and Prospective Increases

It is true that the U. S. is now producing at its maximum efficient rate,

with no additional productive capacity available from present wells with transportation. It is likewise true that no where else in the world is there at the moment any noteworthy amount of additional production available at tidewater for shipment. These limitations on supply are transitory, however; they will not be with us always.

In the U. S. in 1948 we have been drilling many more wells than in 1947. Most of these are development wells, in proved fields. They are part of the drilling we need to do to catch up with our war-caused deficiency. These wells will yield results. I look for a further increase in crude production during the next few months. I look for continued increases in production for many years to come.

Dry Land and Offshore Prospects

Whether these increases will be great enough to keep pace with increasing demand I am inclined to doubt, if our activities are confined to dry land. The answer may be very different, however, if, by whatever means, our submerged lands become fully and quickly available for exploration and development.

At the 1948 annual meeting of the American Association of Petroleum Geologists, I heard many stories of the increasing difficulty of finding oil in the U. S. The founder and head of one of the most successful geophysical companies told me that ten to 15 years ago they could virtually guarantee a client that six months of seismic shooting would turn up at least one prospect worth drilling. Now, he said, five years of seismic work for some clients have not revealed a prospect worth drilling. This was the story on land.

Offshore, however, the story was different. He said shooting off the coast of Louisiana and Texas was a geophysicist's paradise, comparable to applying modern geophysical techniques to the present Gulf Coast productive area when it was virgin territory. "Almost every survey you shoot," he said, "you turn up a good-looking structure."

If the submerged lands become legally accessible in the near future, only a few years may be required for production to catch up with increasing demand, even though demand should outrun present forecasts.

World Prospects

The rest of the world offers even more alluring prospects. In a recent paper, Lewis G. Weeks[1] estimates the total proved reserves of the world, excluding Russia, at 63 billion barrels. As of January 1, 1944, they were estimated at 44 billion barrels.[2] That is a 43 percent increase in four years.

Weeks[1] has also estimated original ultimate potential reserves, including amounts already produced, that total 110 billion barrels for the U. S. and 500 billion barrels for the rest of the world, and although the U. S. has produced 32 percent of her estimated original reserves the rest of the world has produced only 4 percent.

With such reserves, proved and potential, the demands of the world can surely be met, given the two things that I specified at the outset, a reasonable amount of time and the continued free play of competitive forces.

You may wonder why I do not mention steel as a third requisite, when I have said so often that what we need are time and steel. We do need more steel for the petroleum industry, need it urgently, but time and the free play of competitive forces in the steel industry, as well as in the petroleum industry, will solve our steel problems.

We should press as hard as we know how for more steel at once, as hard as the public is pressing us for more products at once. What we get will hasten the day when petroleum products are again abundant. What we do not get will delay that day; it will call for more time.

Time we must have. New productive capacity can not be created overnight, no matter how great the reserves or how promising the prospective territory. Despite all the efforts of the most virile industry I know, we shall probably be on scant rations for a few years, until the vigor of the industry, released from the restraints that war and postwar conditions have imposed upon it and upon the industries that supply it, can again make petroleum products abundant. Time we must have and time we will get, because there is no escape from the necessity for it.

Prospects for Competitive Freedom

Will we also have a continued free play of competitive enterprise? Of that we cannot speak so confidently.

The tide of nationalism and nationalization in the non-Russian world seems at the moment to be receding a trifle, but the turn is too slight to inspire great confidence. American enterprise is excluded from free operation in a number of countries, including four oil-producing countries in the Western Hemisphere. The terms and restrictions imposed by various other countries grow increasingly severe. The oil resources of the world will not be developed quickly or adequately through Government operation, or by excluding or dealing harshly with foreign enterprise, capital, and know-how.

In our own country, we came perilously close to some measure of government control during recent months. There was before a committee of Congress the most drastic and comprehensive bill for complete regulation of the industry that I ever read. It would have made the entire industry a public utility, subject to the control of a commission in its every operation and its every price, from exploration to distribution, from the geophysicist to the filling station attendant. It was not pressed, nor were the numerous other bills calling for lesser measures of control, but any of them could come to life at any time.

Congressmen were led to propose drastic measures by last winter's outcry from the people who could not get the oil they needed, or feared they could not.

The cries were heard and heeded the more readily because they were unexpected. Even when the shortage was already being felt, too many oil industry leaders assured Congressional committees that there was no shortage and no prospect of one.

I hope we shall not repeat that mistake, but I am not too sanguine. Some of the same industry leaders are repeating the same assurances for next winter. I wish that I could share their unqualified optimism.

I am confident that we will overcome our present difficulties, not all of them this year or next year or the year after, but before many years have gone by. I have high hope that we shall come through these years without permanent Government controls, and emerge free from even the controls that are now exercised, such as control of exports, tank car movements, and the like. I believe that we shall come through them with a virile and intensely competitive industry, with American companies developing their full share of world-wide productive capacity in competition with oil men of other nations, and with the domestic industry growing in size and strength despite competition from overseas sources.

Given time and freedom, as I said at the start, we shall have a greater petroleum industry at home and abroad than we have heretofore dreamed, and a more abundant supply of better products at lower relative costs than ever before.

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[1] Weeks, Lewis G., *Highlights on Developments in Foreign Petroleum Fields in 1947*, prepared for publication by American Association of Petroleum Geologists, 1948.

[2] Heroy, William B., *Petroleum in War and Peace*, Government Printing Office, Washington, D. C., 1945, p. 92.

What's New in Oil Field Housing?

Part 1

Packaged Aluminum Houses

By AL REESE
Managing Editor

ALUMINUM has found a new major application in the oil industry.

Frequently used as a substitute material—sometimes excellent, sometimes not—the light metal has been adapted to a use for which it is aptly fitted and in which it may be fiercely competitive, even in an economy not harassed by shortages.

Aluminum has set up housekeeping in the oil field housing business with sound reason to believe it has a long-term lease.

Aluminum houses as such are not new to the industry. Kuwait Oil Company, Ltd., bought 33 of them from one company for use in the desert, where the blistering days and chilly nights offer a problem that well insulated and refrigerated aluminum houses may solve. Socony-Vacuum Oil Company obtained four for the bug-infested, lumber-short Venezuelan fields. Other aluminum buildings of assorted types are sparsely scattered about the oil fields of the U. S.

To some extent these aluminum houses were built as a substitute; a satisfactory substitute, in most instances, but nevertheless a substitute. They were light in weight, cool, rust-proof, rot-proof, bug-proof, but there were disadvantages in construction which prevented full acceptance by an industry that needed housing in a hurry.

These faults apparently have been overcome by a newly developed simplified construction plan called alumi-panel. Involving little that is basically new in materials, the panel plan is essentially a revolutionary approach to building technique.

The inventor and manufacturer ascribes most of the faults in other aluminum buildings to the insistence of designers that an aluminum house be built by the same method as a wooden house. The result, he claims, was a profusion of easy-to-lose nuts and bolts and a confusion of hard-to-erect aluminum studs, rafters, and the myriad other pieces that go into conventional houses.

The bed-rock essentials of the new plan are two: first a standardized panel that permits a purchaser to fill his housing needs by ordering so many square feet of housing space rather than a given number of houses (Figure 1); and second, a locking key which replaces nails, nuts and bolts and allows the erection of any aluminum house, plumbing excepted, with no tool but a hammer (Figure 2).

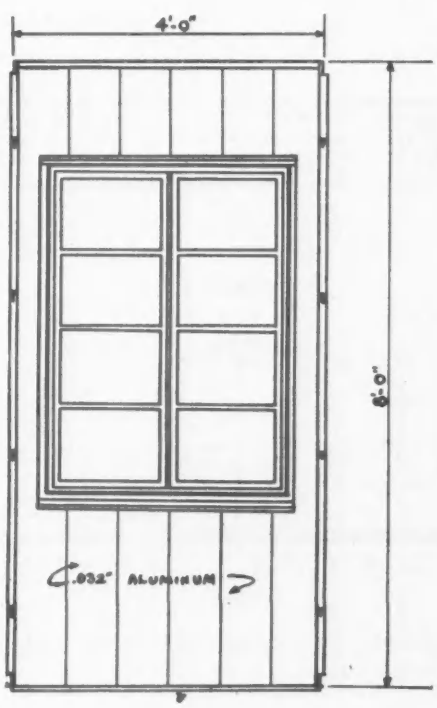


FIGURE 1

The panel construction scheme permits extreme flexibility. For instance, suppose a warehouseman ordered enough panels to build six 4-room houses. While the material was in transit, he received an urgent request for three 6-room houses and an office building with space equivalent to another 6-room house. When the panels arrived, he could fill the new need.

Other advantages:

1. The house comes in completely packaged units. There is nothing else to buy—no wiring, plumbing, furniture or window glass.

2. The buildings are fire-proof, vermin-proof, rust-proof, rot-proof, and are cool. They are insulated with three dead air spaces faced with aluminum foil, providing a wall that is almost refrigeration-type.

3. Complete salvage is possible. By using the locking keys instead of nails, nuts and bolts, the buildings can be disassembled quickly. Lightness of the metal and size uniformity of the panels simplify and reduce the cost of transportation. A packaged, two-bedroom house can be shipped to Guam, 9000 miles from the factory, for $1200.

4. The houses can be speedily constructed. A competent supervisor and eight unskilled laborers can erect a medium-sized alumi-panel house in four days, complete with wiring and plumbing.

Alumi-panel buildings cost $7.50 per square foot, including prefabricated flooring, and the labor cost of erecting a medium-sized building is about $750. The manufacturer admits this initial outlay to be greater than for wooden

houses, but doubts that any other buildings will outlast aluminum houses.

The alumi-panel system employs 4 x 12-foot floor panels over which is welded corrugated aluminum flooring. The corrugations are filled in with mastic cement to provide a level surface upon which is laid asphalt tile or hardwood floors.

The walls are made up of five types of panels: one with casement window; one with outside venetian blinds and aluminum screens for use in the tropics or southwest areas of the U. S.; one with a door; one a blank panel; and one a corner panel, which is different from the blank panel in that it has locking sections for right-angle connections to the adjacent wall.

All panels are 4 x 8 feet, permitting the construction of any size building in multiples of four feet.

A cross-section of any outside panel (see Figure 3) except the door panel contains a strip of .032-inch aluminum, a dead air space 15/16-inch thick, a strip of aluminum foil, another dead air space ¾-inch thick, another strip of aluminum foil, a strip of insulating board ½-inch thick, then a 0.025-inch aluminum interior pan. The crinkled aluminum foil hangs inside the panels like curtains.

Wall panels are put up one by one and locked together and to the floor with keys which replace nails and bolts.

Being interchangeable, the panels make it easy to remove a section of wall to add another room. This arrangement should also delight the lady of the house whose whims for rearranging a home were previously limited to furniture juggling. By locking and unlocking a few keys she can move a door from one side of the house to another or install a window where none existed before. It is even theoretically possible that a late-coming husband may find his irate spouse has replaced all the door panels with blank panels, emphatically denying him entrance, and has set up for his use in the back yard an aluminum dog house, 4 x 8 feet, complete with an aluminum pan, air conditioning and reading lamp.

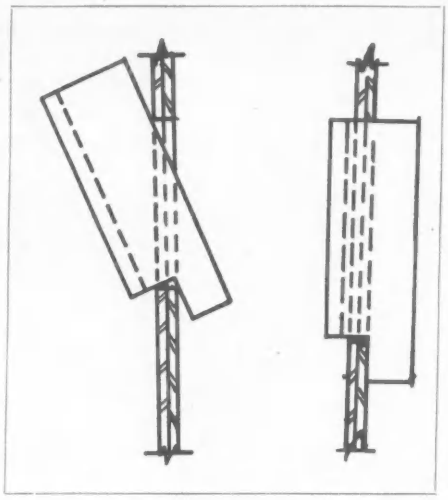


FIGURE 2. Left, key ready to drive. Right, key in locked position.

The same elasticity of design is in the interior walls, which are formed of five standard aluminum plank partition sections ranging from 2 to 16 inches wide, 8 to 10 feet long, and 4 inches thick. With these, the interior of any house can be arranged to duplicate any other of similar size.

The partition panels are designed to slip into an aluminum channel at the floor and ceiling lines. Joints between panels are of the tongue-and-groove type and wedge tightly together.

An ingenious contrivance is the plumbing panel, complete with all pipes, soil stack, tubing for gas fixtures, wiring and circuit breaker load center. Hand holds are provided in the panel so that the purchaser can slide in the kitchen range, bath tub, etc., and connect them with a wrench.

Wiring in the panels is connected at either end with male and female connectors. Thus, in replacing one panel with another to add or take out a door or window, the wiring is disconnected as the old panel is removed, and connected again as the new panel is slipped into place. For simplicity's sake, no wiring is carried above the ceiling or below the floor panels.

The new method makes a complete departure from conventional construction in the matter of roof and ceiling. The ceiling is supported by a tie rod to the ridge cap (Figure 4). The roof is supported only by the walls.

Roofing comes in 4 x 12-foot deeply corrugated strips that overlap to prevent leaking. The ceiling panels are 4 x 12 feet and consist of .027-inch aluminum and ½-inch insulating board topped by insulating foil.

Packaged with each building as standard equipment are a tub, shower, toilet, aluminum kitchen cabinets, built-in central heating and kitchen sink.

Optional equipment includes complete air conditioning, a complete set of furniture, aluminum kitchen ware, gas or electric refrigerator, and gas or electric range.

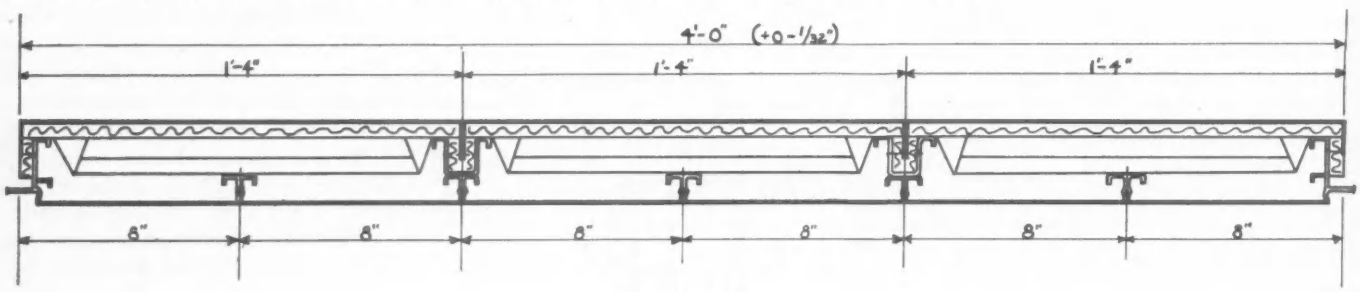


FIGURE 3

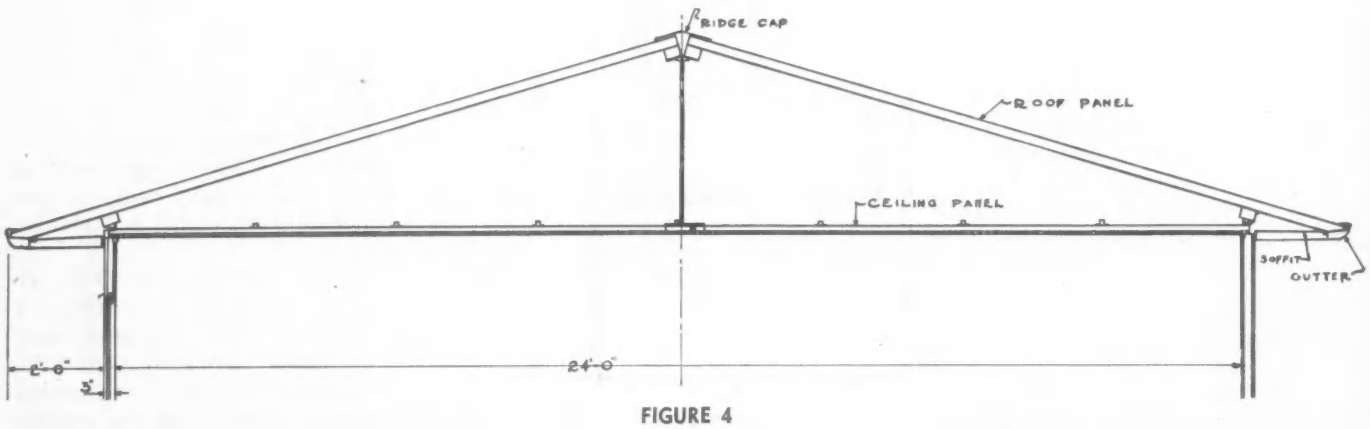


FIGURE 4

FOR DWELLINGS, OFFICES, WAREHOUSES, WILDCAT UNITS — ANY ONE-STORY STRUCTURE

ALUMI—PANEL

Revolutionizes Construction Methods!

LOOK LIKE AND ARE *PERMANENT* STRUCTURES, NOT TEMPORARY —
CAN BE QUICKLY DISMANTLED FOR CHANGE OF LOCATION

These and other superior and exclusive features are now offered for the first time only by ALUMI-PANEL:

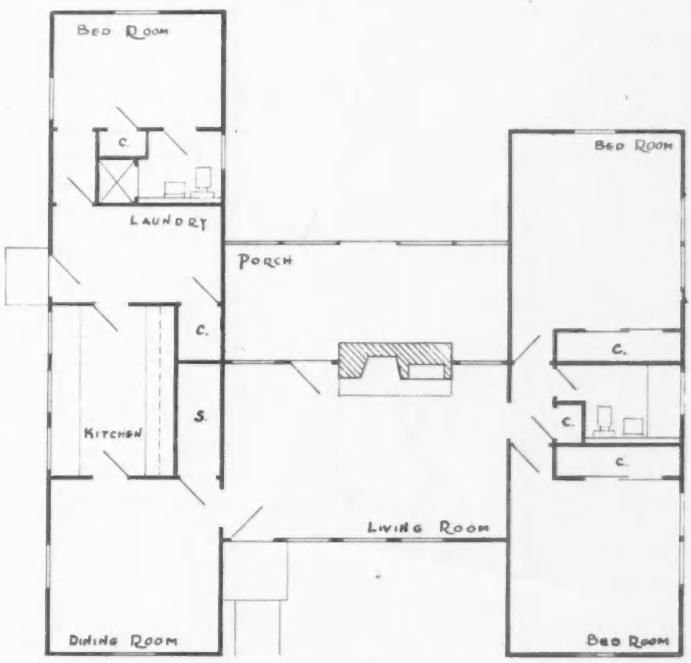
1. **"50-year housing" stability & design!**
2. **Erection or dismantling in the field by unskilled labor with hammer and pipe wrench.**
3. **Panels interchangeable, offering unlimited design possibilities—no more frozen designs. Your architects tell us your requirements and we do the rest.**
4. **Complete package service, including panels, wiring, plumbing, air conditioning units with thermo-pane fixed windows, casement windows or outside venetian blinds with screens; refrigerators, ranges, central heating, kitchenware and furniture.**
5. **Refrigerator-type insulated wall panels give uncanny protection against heat or cold.**
6. **Cost averages about $7.50 per square foot including pre-fab floors.**

Totally Different, Built to Last

ALUMI—PANEL

A DEVELOPMENT OF F. VINTON LONG

"DESIGNS UNLIMITED"



Illustrated is one of the numerous designs applicable to oil field staff houses that are vermin-proof, fire resistant and rat-proof.

YOU SUPPLY THE OCCUPANTS — WE DO THE REST

ALUMINUM OILFIELD EQUIPMENT, Inc.

412 MAIN STREET, HOUSTON 2, TEXAS

Cable Address: EMPRESAS HOUSTON

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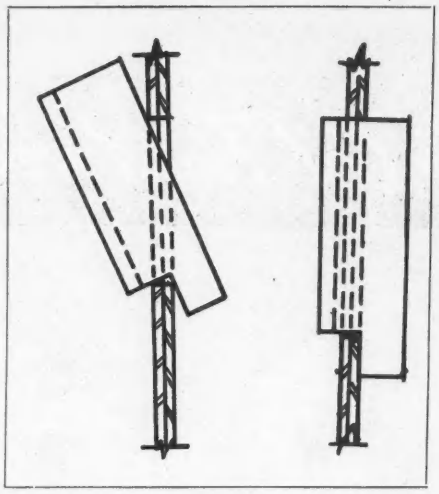

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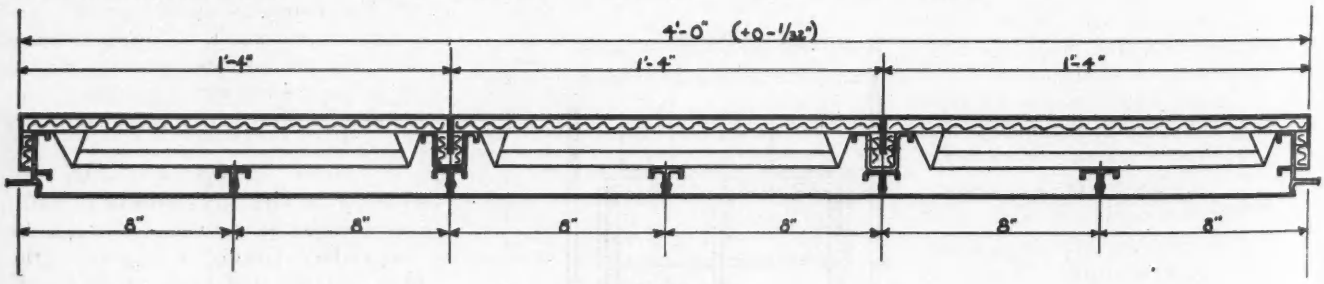


FIGURE 3

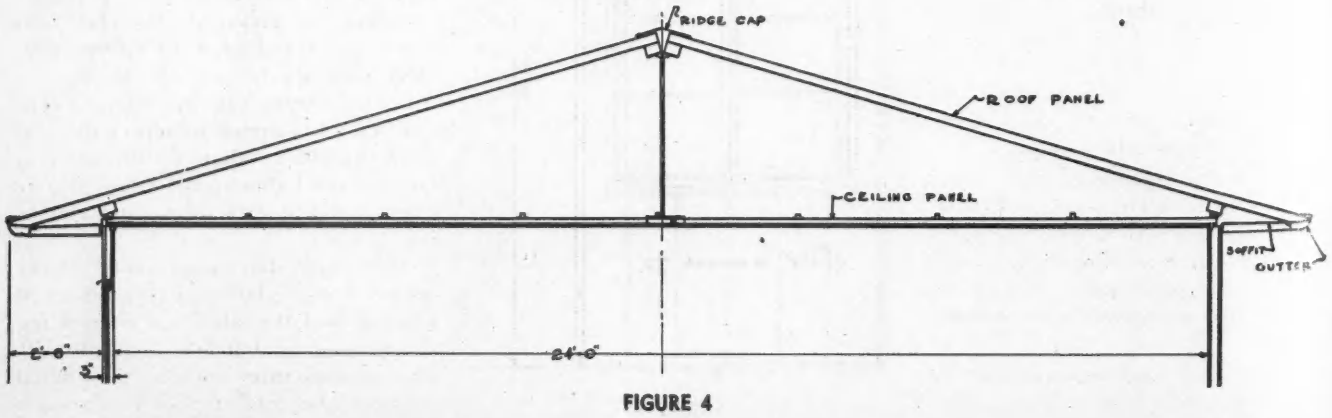


FIGURE 4

FOR DWELLINGS, OFFICES, WAREHOUSES, WILDCAT UNITS — ANY ONE-STORY STRUCTURE

ALUMI—PANEL

Revolutionizes Construction Methods!

LOOK LIKE AND ARE *PERMANENT* STRUCTURES, NOT TEMPORARY —
CAN BE QUICKLY DISMANTLED FOR CHANGE OF LOCATION

These and other superior and exclusive features are now offered for the first time only by ALUMI-PANEL:

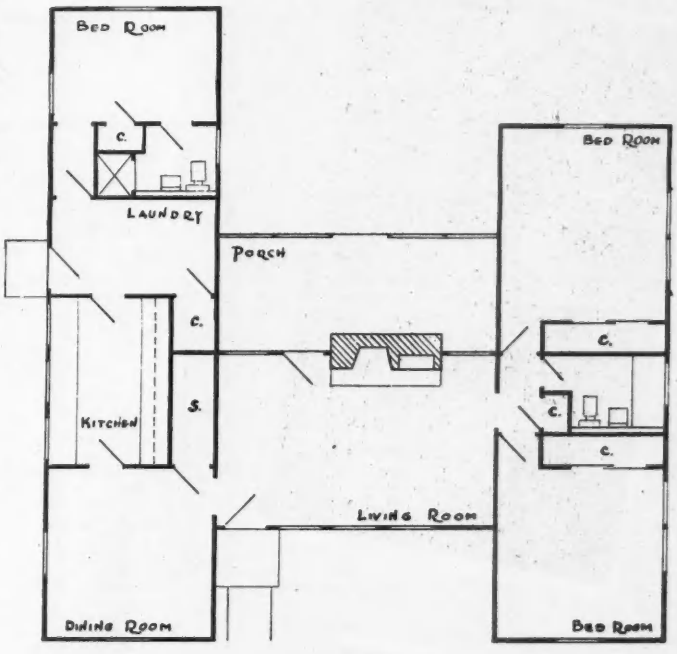
1. **"50-year housing" stability & design!**
2. **Erection or dismantling in the field by unskilled labor with hammer and pipe wrench.**
3. **Panels interchangeable, offering unlimited design possibilities—no more frozen designs. Your architects tell us your requirements and we do the rest.**
4. **Complete package service, including panels, wiring, plumbing, air conditioning units with thermo-pane fixed windows, casement windows or outside venetian blinds with screens; refrigerators, ranges, central heating, kitchenware and furniture.**
5. **Refrigerator-type insulated wall panels give uncanny protection against heat or cold.**
6. **Cost averages about $7.50 per square foot including pre-fab floors.**

Totally Different, Built to Last

ALUMI—PANEL

A DEVELOPMENT OF F. VINTON LONG

"DESIGNS UNLIMITED"



Illustrated is one of the numerous designs applicable to oil field staff houses that are vermin-proof, fire resistant and rat-proof.

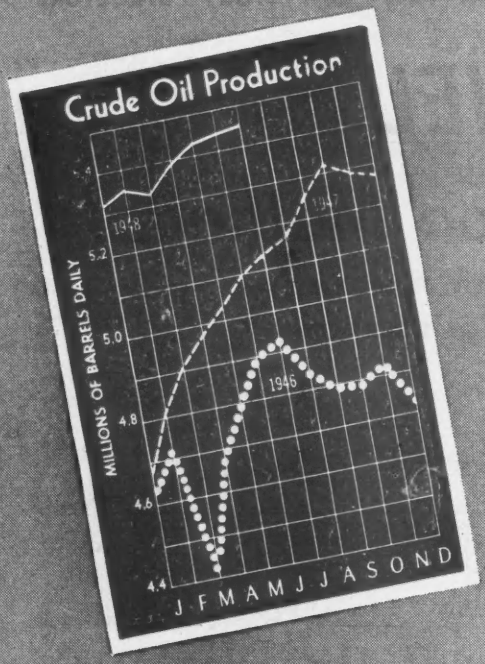
YOU SUPPLY THE OCCUPANTS — WE DO THE REST

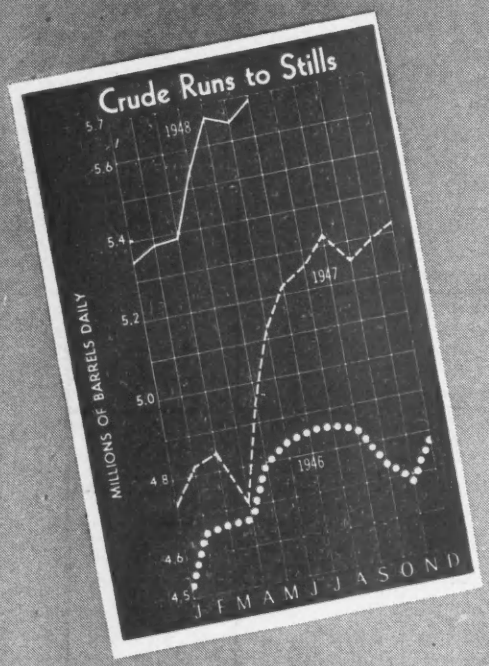
ALUMINUM OILFIELD EQUIPMENT, Inc.

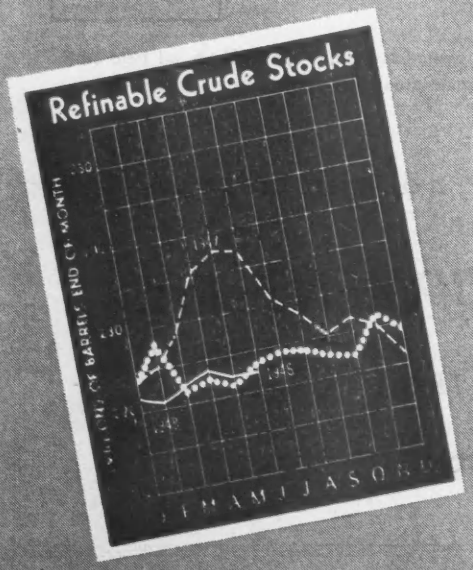
412 MAIN STREET, HOUSTON 2, TEXAS

Cable Address: EMPRESAS HOUSTON

Refinery Runs at New High;







REFINERY operations were pushed to higher levels during July as the industry continued its efforts to see the summer through without serious gasoline shortages and to lay in ample fuel oil supplies for the winter. The possibility that supplies would not meet these seasonal demands has been the cause of considerable concern and though prospects now seem to be much brighter, there still remain possibilities that some areas will feel the pinch of temporary shortages.

A large part of the touring season is over and although the motoring public has been using about 10 percent more gasoline than it did last year, not too much difficulty has been experienced. Some suppliers, particularly in the Middle West, have found it necessary to allocate their supplies in order to equitably distribute them. The heaviest part of the season, the Labor Day weekend, is still ahead but, fortunately, this heavy demand period will be short. Even so, some localities may be short on gasoline. Overall stocks of gasoline present an impressive total and amount to over 15 percent more than they did a year ago, but the key to balanced supply and demand is the distribution of stocks, and not necessarily the grand total.

The distribution problem has been somewhat improved since last year with the completion of new pipe lines and the addition of a number of tank ships. Not only have these helped the Nation's gasoline users, but they will help this winter's fuel oil consumers. The fuel oil problem is also one of

Crude Oil and Refined Products Trends

(THOUSANDS OF BARRELS)

MONTH	CRUDE OIL			GASOLINE		DISTILLATE FUEL		RESIDUAL FUEL	
	Production Daily	Runs to Stills Daily	Stocks End of Month	Production Daily	Stocks End of Month	Production Daily	Stocks End of Month	Production Daily	Stocks End of Month
1945:									
January	4,756	4,680	221,737	2,094	91,666	663	31,695	1,350	44,347
February	4,767	4,817	220,221	2,194	97,457	724	27,210	1,326	39,760
March	4,804	4,719	223,988	2,124	97,447	675	26,729	1,273	35,451
April	4,807	4,774	224,229	2,127	90,804	681	29,148	1,289	34,418
May	4,887	4,913	223,151	2,179	88,530	708	29,511	1,341	34,333
June	4,859	4,989	218,218	2,166	86,128	730	32,440	1,351	35,606
July	4,897	5,001	216,638	2,281	85,582	713	36,276	1,351	38,341
August	4,870	4,928	215,135	2,269	84,003	701	41,245	1,329	42,227
September	4,423	4,275	220,319	1,933	74,574	640	45,059	1,139	42,822
October	4,284	4,244	221,246	1,888	76,805	613	45,479	1,176	42,008
November	4,517	4,624	218,916	2,156	86,540	665	44,562	1,265	41,322
December	4,472	4,574	218,763	2,056	97,676	683	35,778	1,245	37,158
1946:									
January	4,625	4,520	223,442	1,914	102,394	787	28,990	1,224	34,573
February	4,719	4,651	227,220	1,884	104,836	823	25,511	1,243	34,008
March	4,414	4,661	221,400	1,900	104,161	815	29,922	1,213	32,995
April	4,673	4,663	222,480	1,943	98,744	773	32,064	1,247	35,206
May	4,785	4,794	221,592	2,016	93,960	753	33,385	1,220	38,932
June	4,896	4,836	223,140	2,055	91,971	777	38,824	1,219	41,492
July	4,922	4,856	224,351	2,102	87,778	793	46,439	1,163	45,446
August	4,836	4,856	224,157	2,189	86,745	765	54,068	1,159	48,186
September	4,790	4,839	222,417	2,143	87,021	796	62,019	1,150	54,012
October	4,785	4,736	222,177	2,117	85,952	788	76,780	1,090	55,580
November	4,823	4,684	226,453	2,162	88,587	791	68,145	1,101	52,735
December	4,725	4,789	224,473	2,168	92,742	805	59,912	1,159	47,094
1947:									
January	4,671	4,739	223,848	2,078	99,623	778	48,197	1,174	41,550
February	4,810	4,820	225,121	2,089	103,672	777	36,901	1,228	48,480
March	4,908	4,843	228,981	2,076	105,679	825	31,423	1,222	37,403
April	4,974	4,707	235,710	2,037	101,724	764	30,268	1,148	36,455
May	5,033	4,947	237,768	2,128	95,209	805	34,279	1,204	39,992
June	5,099	5,120	237,278	2,258	89,774	807	39,676	1,233	43,515
July	5,137	5,221	230,974	2,302	86,003	847	46,444	1,244	47,600
August	5,173	5,260	228,523	2,383	85,849	869	54,707	1,245	51,334
September	5,251	5,236	225,258	2,375	84,360	911	59,764	1,237	52,578
October	5,320	5,253	226,666	2,371	82,584	938	63,252	1,260	52,502
November	5,291	5,291	225,462	2,332	87,551	942	61,334	1,245	52 455
December	5,337	5,350	224,929	2,347	92,303	992	51,081	1,282	47,091
1948:									
January	5,283	5,348	223,430	2,328	102,167	1,082	41,036	1,278	44,636
February	5,353	5,380	224,880	2,264	110,999	1,127	34,590	1,295	43,156
March	5,406	5,387	227,408	2,252	111,949	1,050	32,214	1,307	41,945
April	5,484	5,540	227,278	2,396	109,829	978	34,514	1,303	43,301
May	5,502	5,668	223,820	2,486	108,552	992	40,781	1,314	48,518
June	5,486	5,644	223,011	2,550	104,145	1,013	46,521	1,288	52,470
July	5,460	5,685	223,137	2,549	99,116	1,011	56,661	1,288	58,130
July, 1948 Change:									
In Month	−26	+41	+126	−1	− 5,029	−2	+ 10,140	....	+5,660
In One Year	+323	+464	−7,837	+247	+ 13,113	+164	+ 10,217	+44	+ 10,530
In Two Years	+538	+829	−1,214	+447	+ 11,338	+218	+ 10,222	+125	+ 12,684

Trends

Crude Production Drops

distribution. At the peak of last winter when there were fuel oil shortages in the Middle West and on the East Coast, it was hard for those depending on oil to heat their homes to find much solace in the fact that there were about 70 million barrels of fuel oil stocks.

However, the improved gasoline stocks position will help the industry towards meeting winter's fuel oil needs. With these stocks at comparatively high levels the shifting of refinery yields in favor of fuel oil can be effected sooner than was possible last year. The big push for gasoline continued through September last year and as stocks at that time were considerably lower than they are now, refiners had to continue to concentrate on motor fuel production. Some refiners have already begun to bear down on fuel oil output. This, plus the fact that fuel oil stocks are in good position and mounting rapidly, greatly reduces the possibility of serious winter shortages. However, an extreme winter could still produce spot shortages of fuel oil.

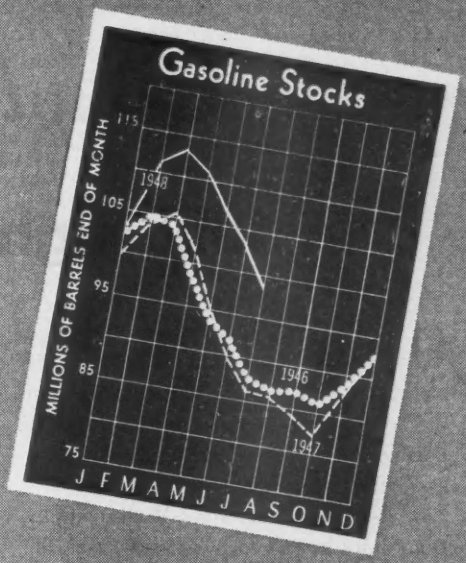
Refinery runs during July averaged 5,685,000 barrels daily, a new all-time high and an increase of 464,000 barrels a day over runs a year ago. Crude oil production slumped slightly from the previous month, but still it amounted to a near record high of 5,460,000 barrels a day, which topped output of a year before by 323,000 barrels daily.

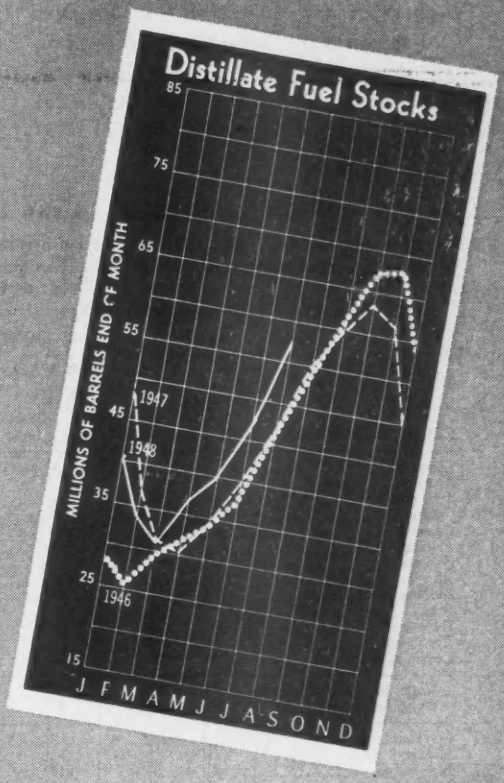
Stocks of finished and unfinished gasoline totaled 99,116,000 barrels at the end of July, a drop of 5,029,000 barrels during the month but 13,113,000 barrels more than was in storage a year ago.

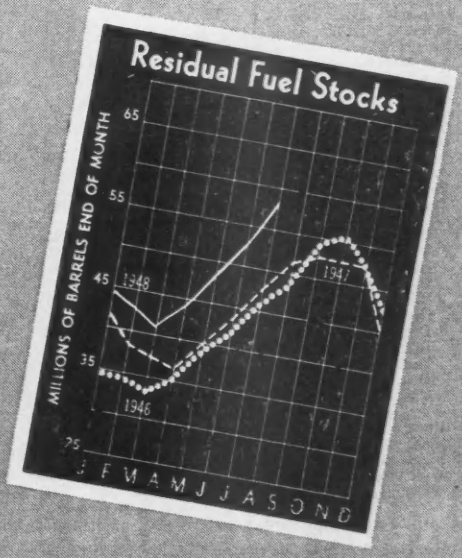
Addition of 10,140,000 barrels of distillate fuel oil during July boosted stocks of these light domestic fuels to a total of 56,661,000 barrels, which was 10,217,000 barrels over inventories a year before. Stocks of heavier residual fuel oils gained 5,660,000 barrels to total 58,130,000 barrels. A year ago they had totaled 47,600,000 barrels, 10,530,000 barrels below the current amount.

State Crude Oil Production
(THOUSANDS OF BARRELS)

STATE OR DISTRICT	DAILY AVERAGE PRODUCTION				TOTAL FIRST SEVEN MONTHS		
	July, 1948	June, 1948	July, 1947	% Diff. July, '47-'48	1948	1947	% Diff. '47-'48
Alabama	1.3	1.4	1.1	+ 18.2	274	216	+ 26.9
Arkansas	81.8	82.6	81.9	— 0.1	18,039	17,098	+ 7.1
California	948.7	951.2	918.2	+ 3.3	200,656	192,017	+ 4.5
Colorado	47.9	47.1	46.8	+ 2.4	9,788	8,496	+ 15.2
Florida	0.9	0.8	1.0	— 10.0	169	130	+ 30.0
Illinois	171.9	172.6	179.9	— 4.4	36,779	39,232	— 6.3
Indiana	20.7	20.0	16.7	+ 24.0	3,582	3,605	— 0.6
Kansas	297.6	303.5	295.6	+ 0.7	62,922	60,091	+ 4.7
Kentucky	24.0	24.1	26.3	— 8.7	5,021	5,387	— 6.8
Louisiana	475.8	469.2	439.1	+ 8.4	101,936	90,492	+ 12.6
North Louisiana	113.1	112.9	98.0	+ 15.4	24,499	20,670	+ 18.5
South Louisiana	362.7	356.3	341.1	+ 6.3	77,437	69,822	+ 10.9
Michigan	43.5	44.3	45.1	— 3.5	9,488	9,142	+ 3.8
Mississippi	124.3	121.6	96.0	+ 29.5	25,645	18,977	+ 35.1
Missouri	0.1	0.1	0.2	— 50.0	31	31	.....
Montana	26.2	25.3	23.9	+ 9.6	5,279	4,913	+ 7.4
Nebraska	0.4	0.4	0.6	— 33.3	123	130	— 5.4
New Mexico	129.1	128.2	109.3	+ 18.1	27,338	22,572	+ 21.1
New York	14.2	14.2	13.7	+ 3.6	2,776	2,771	+ 0.2
Ohio	9.7	10.2	9.1	+ 6.6	1,920	1,749	+ 9.8
Oklahoma	423.2	426.9	388.6	+ 8.9	87,788	79,999	+ 9.7
Pennsylvania	33.8	33.9	35.8	— 5.6	7,322	7,364	— 0.6
Tennessee	.....	.....	.....	.....	4	5	— 20.0
Texas	2,427.7	2,455.3	2,282.7	+ 6.4	516,377	458,785	+ 12.6
Dist. 1—South Central	25.9	28.6	22.3	+ 29.6	5,688	4,401	+ 29.2
Dist. 2—Middle Gulf	177.3	173.7	155.0	+ 14.4	36,693	32,563	+ 12.7
Dist. 3—Upper Gulf	491.2	497.6	483.5	+ 1.6	105,312	99,749	+ 5.6
Dist. 4—Lower Gulf-S.W.	249.0	256.4	230.9	+ 7.8	54,096	49,514	+ 9.3
Dist. 5—East Central	48.3	47.0	39.2	+ 23.2	9,724	7,996	+ 21.6
Dist. 6—Northeast	424.8	433.9	438.1	— 3.0	91,855	92,120	— 0.3
Dist. 7-B—N. Central	49.3	48.3	37.3	+ 32.2	9,688	7,828	+ 23.8
Dist. 7-C—West Central	42.9	46.0	39.0	+ 10.0	9,412	7,451	+ 26.3
Dist. 8—West	691.0	697.6	586.4	+ 17.8	144,394	108,194	+ 33.5
Dist. 9—North	136.3	139.9	126.1	+ 8.1	29,679	27,718	+ 7.1
Dist. 10—Panhandle	88.7	86.3	84.2	+ 5.3	18,423	17,951	+ 2.7
Virginia	0.1	0.2	0.1	.....	30	48	— 37.5
West Virginia	7.4	7.4	7.0	+ 5.7	1,546	1,470	+ 5.2
Wyoming	149.4	145.4	117.9	+ 26.7	30,681	24,400	+ 25.7
Total United States	5,459.7	5,485.9	5,136.6	+ 6.3	1,155,514	1,049,120	+ 10.1







Completions

In July Highest of Year

DRILLING operations which already had been high during the first half of the year were stepped up even more during July to give the second half a good start towards continuing the year's record-breaking activity. Well completions numbered 3528 in July for the highest of any month so far this year and boosted the seven-months' total to 21,540 wells. This total represents an increase of 18 percent over the 18,251 wells completed through July of 1947 and goes a long way towards justifying the recently revised forecast of slightly over 38,000 wells for 1948.

July's wells topped the 3287 completed in the same month a year ago by 241 wells, or over seven percent, and the total number of feet of hole drilled in these wells showed an even greater increase. A year ago each new well drilled averaged 3442 feet, while in the month just passed each hole was carried to an average of 3455 feet.

Although the number of wells and the footage drilled in the two periods were considerably unlike, the percentages of successful drilling were almost identical. In July, 1947, of the total wells drilled for oil or gas, 67.6 percent were successful, while this month's records showed a slightly lower success ratio of 67.4 percent. In arriving at these percentages, only the wells that had oil or gas as an objective were counted and service wells such as disposal and input wells were not considered.

In the first seven months of last year there were 16,703 new wells drilled in search of production. Of these 11,639 found the pay for a score of 69.7 percent. So far this year 20,065 wells aimed at production have been completed and these have netted 13,738 producers for a count of 68.5 percent of the total. In both cases, more than two out of every three wells drilled for oil or gas have proven successful, with last year holding a very slight edge in this comparison.

Well Completions in the United States During July, 1948, and Cumulative for Year

(Figures compiled by WORLD OIL Staff from private reports and other sources as follows: Illinois from Illinois Geological Survey; Indiana from Indiana Division of Geology; Missouri from Missouri Geological Survey; Tennessee from Tennessee Division of Geology; Bradford, Kane-Clarendon, and Allegany fields of Pennsylvania and New York from The Producers' Monthly)

STATE OR DISTRICT	MONTHLY COMPLETIONS, JULY, 1948 — NEW WELLS: Oil	Dist.	Gas	Dry	Water Input	Gas Input	Water Disposal	Total New	Total Drilled Deeper	TOTAL COMPLETIONS: July, 1948	June, 1948	July, 1947	Footage July, 1948	CUMULATIVE TOTAL: Wells 1948	Wells 1947	Percent Diff.	Footage 1948	Rigs in Operation (Drilling, Rigging Up and Shut Down): July 31, 1948	June, 30, 1948	July 31, 1947
Alabama				3				3		3	2	3	23,239	11	12	— 8.3	59,416	2	3	8
Arizona											1			1			630	6	6	2
Arkansas	20		3	15				38		38	25	26	157,264	177	146	+ 21.2	715,257	45	49	31
California	177		3	33				213	3	216	258	143	722,026	1,491	1,077	+ 38.4	5,210,735	272	282	254
Colorado	11			5				16	2	18	20	25	81,107	142	104	+ 36.5	758,125	46	52	74
Florida				4				4		4	2	2	24,103	16	19	— 15.8	97,243	5	7	6
Georgia												2		2	3	— 33.3	8,871			1
Illinois	143		1	135				279		279	235	188	728,012	1,309	1,090	+ 20.1	3,418,347	237	241	235
Indiana	37		2	48				87		87	106	58	187,561	552	313	+ 76.4	1,044,420	105	111	87
Iowa																				
Kansas	118		55	87			1	261		261	332	274	855,920	1,670	1,395	+ 19.7	5,484,540	257	266	378
Kentucky	28		23	30				81		81	78	93	151,295	439	488	— 10.0	870,787	88	80	119
Louisiana	120	12	14	48			1	195	1	196	216	184	1,009,114	1,220	807	+ 51.2	6,171,058	214	226	196
North Louisiana	84	6	13	27				130	1	131	132	128	438,931	775	454	+ 70.7	2,161,749	73	73	61
South Louisiana	36	6	1	21			1	65		65	84	56	570,183	445	353	+ 26.1	4,009,309	141	153	135
Maryland														1			5,259			
Michigan	38		7	41				86		86	65	66	189,812	397	344	+ 15.4	910,519	118	117	134
Mississippi	21	5	1	11				38		38	34	51	304,938	231	264	— 12.5	1,884,069	48	56	85
Missouri	1			4				5		5		2	1,523	31	28	+ 10.7	9,965	8	8	5
Montana	16		3	9				28		28	21	34	67,700	169	107	+ 57.9	421,200	51	48	72
Nebraska												1		1	1		4,965	2	2	6
Nevada																		1	1	
New Mexico	30		1	12				43		43	66	59	179,248	367	347	+ 5.8	1,483,652	102	109	135
New York	98		3	1	62			164		164	163	187	238,054	1,016	983	+ 3.4	1,478,754	201	207	231
North Carolina															1	—100.0				
Ohio	33		36	34				103	3	106	121	128	250,259	731	757	— 3.4	1,848,052	213	212	239
Oklahoma	199		19	158	1	2	1	380	9	389	333	392	1,355,858	2,307	2,143	+ 7.7	8,080,364	556	565	515
Oregon															1	—100.0				
Pennsylvania	109		32	10	101	16		268	5	273	296	283	453,575	1,867	1,891	— 1.3	3,227,350	421	435	416
South Dakota														1			1,365			
Tennessee											7	2		28	11	+154.5	40,783	18	20	7
Texas	677	12	25	350		2		1,066	17	1,083	984	1,014	4,483,257	6,638	5,324	+ 24.7	28,181,558	1,451	1,452	1,284
Dist. 1—S. Central	22			24				46		46	29	31	127,166	278	179	+ 55.3	866,466	40	46	29
Dist. 2—Middle Gulf	31	3	5	21				60	1	61	56	65	349,736	445	365	+ 21.9	2,569,037	63	69	58
Dist. 3—Upper Gulf	53	3	7	32		1		96		96	101	94	571,000	602	469	+ 28.4	3,919,124	140	126	124
Dist. 4—L. Gulf S.W.	57	5	1	42				105	4	109	128	113	537,894	782	656	+ 19.2	3,800,784	130	125	108
Dist. 5—E. Central	12			5				17		17	25	18	70,813	117	81	+ 44.4	567,731	33	42	29
Dist. 6—Northeast	16	1	5	12				34	1	35	34	56	184,843	218	281	— 22.4	1,192,692	45	47	61
Dist. 7-B—N. Central	54		5	60				119	4	123	124	96	377,447	758	484	+ 56.6	2,352,979	188	177	122
Dist. 7-C—W. Central	21			20				41	1	42	44	27	182,495	227	147	+ 54.4	898,543	73	75	62
Dist. 8—West	241		1	23				265	3	268	233	197	1,298,664	1,638	1,122	+ 46.0	7,504,726	472	479	404
Dist. 9—North	125		1	111		1		238	3	241	181	264	645,414	1,269	1,261	+ 0.6	3,519,310	110	111	162
Dist. 10—Panhandle	45							45		45	29	53	137,855	304	279	+ 9.0	990,166	157	155	125
Utah			1					1		1	3		6,090	13	3	+333.3	54,362	12	9	6
Virginia														1			2,301			
Washington											1			2			11,205			1
West Virginia	11		50	18				79	2	81	57	83	214,132	452	471	— 4.0	1,143,920	388	384	368
Wyoming	29			19				48		48	46	27	218,811	257	121	+112.4	1,028,997	146	142	97
Total United States	1,916	29	279	1,075	164	20	3	3,486	42	3,528	3,472	3,287	11,902,898	21,540	18,251	+ 18.0	73,658,069	5,013	5,090	4,992

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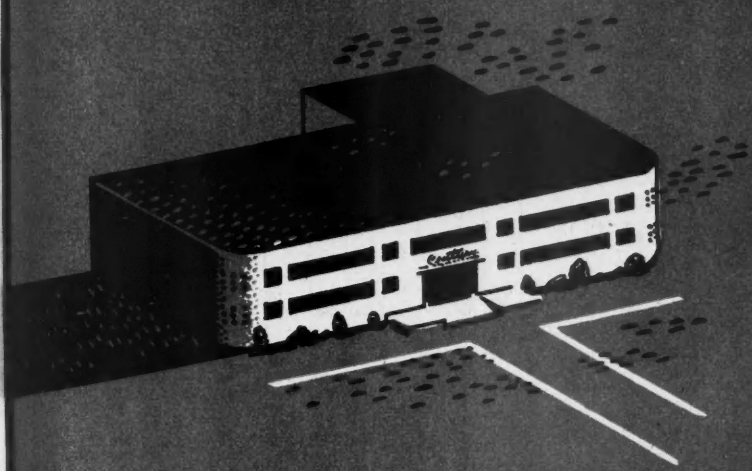


Century GEOPHYSICAL CORPORATION

TULSA, OKLAHOMA

149 Broadway
New York

Neils-Esperson Bldg.
Houston

Exploration

In Tidelands Pays Off in July

By CECIL SMITH, Staff Writer

NEVER before in history has the search for new oil and gas reserves reached the tempo at which it is today. Never have exploratory well completions in one month equaled those made in July nor has any year ever been able to put up a seven-months' record that would even come close to matching the number of exploratory wells completed thus far in 1948. The tidelands' part of this exploration activity got a shot in the arm during the month with the completion of two new producers in the Gulf of Mexico and several others showing for producers.

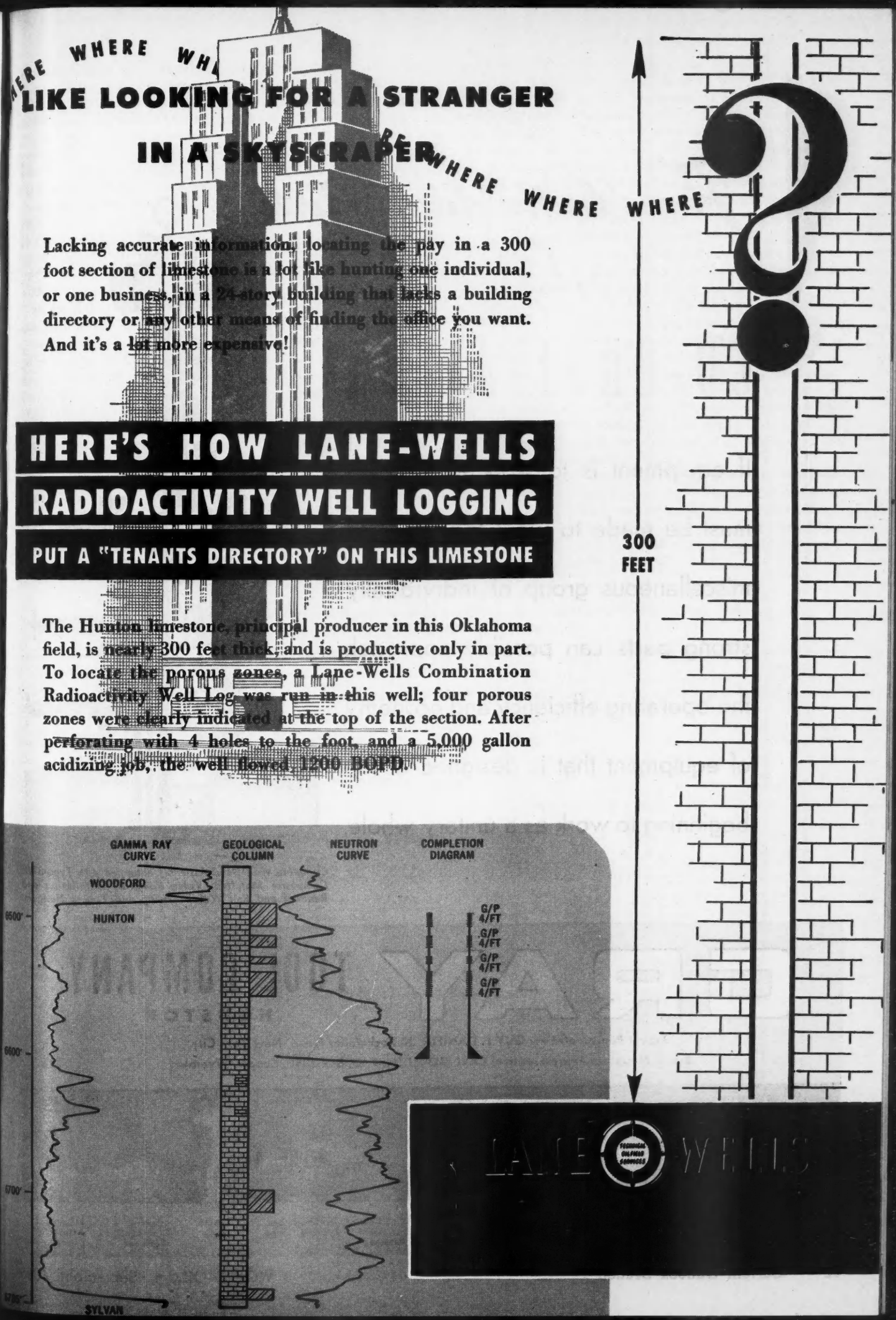
The industry completed 668 exploratory tests in July for a substantial gain over the 597 tests completed in June, which had the distinction of having the second highest all-time mark. A year ago this type of well completions had totaled 524. Not only were July's wells more numerous than ever, but the number that made commercial producers showed a slight and encouraging increase over previous averages. Successful wells totaled 141 in July for a score of 21.1 percent of the total, while only 18.1 percent produced a month earlier. The average for the first seven months of 1948 was 20.1 percent, which shows that July's exploratory drilling

Summary of Results of Exploratory Drilling

ITEM	July, 1948	June, 1948	SEVEN MONTHS: JAN.-JULY 1948	1947	Percent Diff.
Oil Discoveries	87	80	492	394	+ 24.9
New Fields	65	52	311	224	+ 38.8
New Pays	22	28	181	170	+ 6.5
Distillate Discoveries	11	7	56	54	+ 3.7
New Fields	5	6	29	25	+ 16.0
New Pays	6	1	27	29	— 6.9
Gas Discoveries	14	8	74	63	+ 17.5
New Fields	11	6	53	48	+ 10.4
New Pays	3	2	21	15	+ 40.0
Total Discoveries	112	95	622	511	+ 21.7
Extensions to Fields	29	13	122	80	+ 52.5
Oil Fields	28	11	102	58	+ 75.9
Distillate Fields	.....	2	8	9	— 11.1
Gas Fields	1	.....	12	13	— 7.7
Total Prod. Tests	141	108	744	591	+ 25.9
Dry Holes	527	489	2963	2322	+ 27.6
Wildcats	524	484	2920	2251	+ 29.7
New Pays	.....	1	7	36	— 80.6
Outposts	3	4	36	35	+ 2.9
Total Expl'tory Tests	668	597	3707	2913	+ 27.3
Percent Productive	21.1	18.1	20.1	20.3	.....
Percent Dry	78.9	81.9	79.9	79.7	.....

Results of Exploratory Drilling in July and First 7 Months, 1948-1947, by Districts

State or District	MONTH OF JULY, 1948													FIRST SEVEN MONTHS, 1948																
	Productive Tests									Total Productive	Unproductive Tests			Total Exploratory Tests	Productive Tests								Unproductive Tests			Total Dry		Total Exploratory Tests	
	New Fields			New Pays			Extensions								New Fields			New Pays			Extensions			Total Productive						
	Oil	Dis.	Gas	Oil	Dis.	Gas	Oil	Dis.	Gas		Wildcats	New Pays	Outposts		Oil	Dis.	Gas	Oil	Dis.	Gas	Oil	Dis.	Gas	7 Mo. 1948	7 Mo. 1947	Wildcats	New Pays	Outposts	7 Mo. 1948	7 Mo. 1947	7 Mo. 1948	7 Mo. 1947
Alabama											3			3												11			11	8	11	8
Arizona																										1			1		1	
Arkansas	2									2	12			14	4									4	6	56			56	32	60	38
California	1						2			3	32			35	10		1	6			14	1	1	33	14	140			140	152	173	166
Colorado			1							1	5			6			1							1	2	30			30	25	31	27
Florida											4			4												13			13	18	13	18
Georgia																										2			2	3	2	3
Illinois	4			4			11			19	64			83	16			18			25			59	76	273			273	208	332	284
Indiana	4						3			7	20			27	17		1	3			5			26	13	129			129	68	155	81
Kansas	5		1							6	40			46	39		2	2			1			44	41	257	1		258	185	302	226
Kentucky	3									3	5			8	4		1	1			1			7	4	29			29	34	36	38
Louisiana	2	2		4	4		2		1	15	24			39	6	10	4	31	10	2	4	3	1	71	53	131		1	132	151	203	204
North Louisiana	2						1		1	4	15			19	5		2	1			3	2	1	14	11	66			66	99	80	110
South Louisiana		2		4	4		1			11	9			20	1	10	2	30	10	2	1	1		57	42	65		1	66	52	123	94
Maryland																										1			1		1	
Michigan	3									3	24			27	8		3				1			12	10	134			134	109	146	119
Mississippi		1								1	7			8		1					2			3	5	47		1	48	48	51	53
Missouri											4			4												7			7	9	7	9
Montana	1									1	2			3	2			1			1			4	1	17			17	7	21	8
Nebraska																														1		1
New Mexico											8			8	6	1	1	4		1				13	6	38			38	34	51	40
New York																																
North Carolina																														1		1
Ohio			1							1	3			4	1		1				1		7	10	6	21			21	29	31	35
Oklahoma	6		3	2						11	58			69	32	2	11	17			4			66	59	275		1	276	323	342	382
Oregon																														1		1
Pennsylvania																										3			3	3	3	3
South Dakota																										1			1		1	
Tennessee															1									1		19			19	10	20	10
Texas	32	2	4	11	2	3	9			63	204		3	270	156	15	21	87	17	18	39	4	3	360	286	1240	6	31	1277	831	1637	1117
Dist. 1 S. Central											20			20	1			1		1				3	8	109			109	71	112	79
Dist. 2 Middle Gulf			1	1		2				4	16		1	21	10	1	3	13	7	4	3	2		43	40	110	1	6	117	65	160	105
Dist. 3 Upper Gulf	1		2	4	2	1				10	23			33	10	4	3	30	4	4	3	1	2	61	50	148	1	3	152	89	213	139
Dist. 4 L. Gulf-S.W.	2	2		3						7	27		2	36	13	8	4	14	6	9	2	1		57	69	184	1	14	199	136	256	205
Dist. 5 E. Central	2									2	3			5	4			2			1			7	5	42			42	37	49	42
Dist. 6 Northeast	1									1	4			5	2	2		4			5			13	6	37	2		39	30	52	36
Dist. 7-B N. Central	5		1	1			2			9	36			45	43		8	11			4			66	36	223			223	140	289	176
Dist. 7-C W. Cent.	2						1			3	12			15	9			2			2			13	9	57			57	20	70	29
Dist. 8 West	11						5			16	17			33	35		2	3	1		11		1	52	23	98	1	4	103	78	155	101
Dist. 9 North	8			2			1			11	46			57	29		1	7			8			45	38	230		4	234	154	279	192
Dist. 10 Panhandle																									2	2			2	11	2	13
Utah			1							1				1				2						2		11			11	3	13	3
Virginia																		1						1							1	
Washington																										2			2		2	
West Virginia																		2						2	3				2	4	2	7
Wyoming	2			1			1			4	5			9	9			1	11		4			25	6	32		2	34	25	59	31
Total U.S.	65	5	11	22	6	3	28		1	141	524		3	668	311	29	53	181	27	21	102	8	12	744	591	2920	7	36	2963	2322	3707	2913



Lacking accurate information locating the pay in a 300 foot section of limestone is a lot like hunting one individual, or one business, in a 24-story building that lacks a building directory or any other means of finding the office you want. And it's a lot more expensive!

HERE'S HOW LANE-WELLS RADIOACTIVITY WELL LOGGING PUT A "TENANTS DIRECTORY" ON THIS LIMESTONE

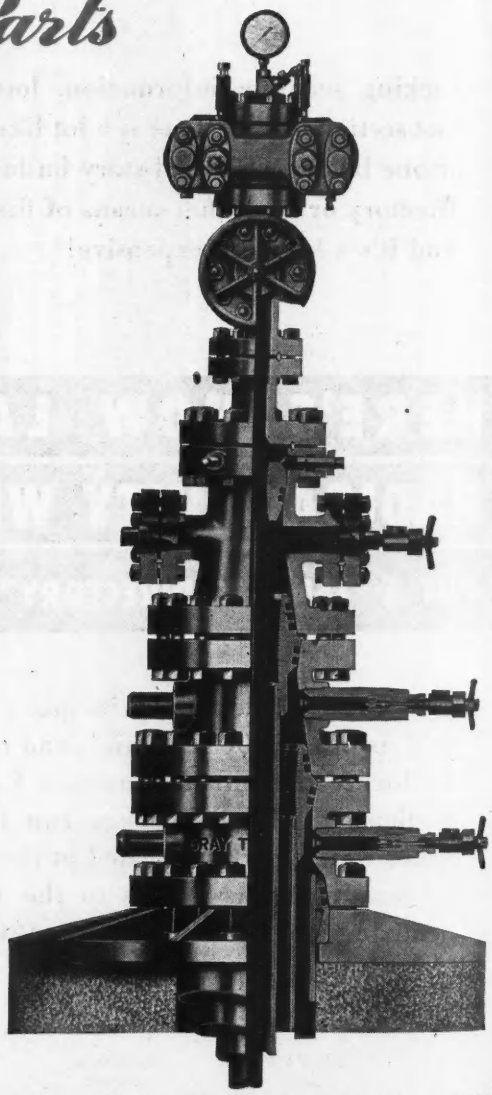
The Hunton limestone, principal producer in this Oklahoma field, is nearly 300 feet thick, and is productive only in part. To locate the porous zones, a Lane-Wells Combination Radioactivity Well Log was run in this well; four porous zones were clearly indicated at the top of the section. After perforating with 4 holes to the foot, and a 5,000 gallon acidizing job, the well flowed 1200 BOPD.

Fine Individual Parts

plus

CO-ORDINATION

If equipment is to work together, it must be made to work together. No miscellaneous group of individually strong parts can possibly approach the operating efficiency and economy of equipment that is designed at the beginning to work as a unitary whole.



Complete Well Head Assembly equipped with Type 3170 Composite Manifold, Valve Removal, Installation and Renewal and Boll Weevil Casing and Tubing Hangers.

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HOUSTON

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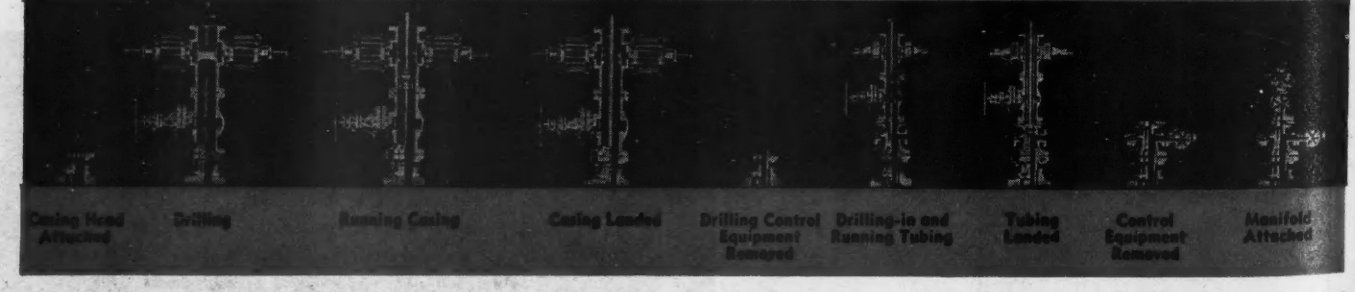


was above average in quality, in addition to setting a new high in quantity.

In the first seven months of this year there have been 3707 tests completed for an increase of 27.3 percent over last year's 2913 in the same period. This year's producers totaled 744 or 20.1 percent of the total and a year ago 591 amounted to 20.3 percent at the end of July. The magnitude of the current exploratory program is clearly indicated by the 27 percent lead over last year's, which broke all previous records with slightly over 5500 tests drilled.

Highlighting July's operations were completion of two more producers in the open waters of the Gulf of Mexico off the coast of Louisiana, the first discovery of the year for Mississippi, and the addition of another oil pay below 14,000 feet in southern Louisiana, the home of deep producers.

Kerr - McGee Oil Industries, Inc.'s State-Ship Shoal No. 2-32, confirmation well for the Block 32 field of Terrebonne Parish located 12 miles offshore in the Gulf was completed in a new oil sand for the field. This well, a directional bore from the same platform of the discovery well, was drilled to total depth of 3238 feet and pipe was perforated at 2808-24 feet in the new sand. On flow test it made 700 barrels of 27.7-gravity oil per day through a 21/64-inch choke. The discovery well flows 25-gravity oil through perforations at 1734-50 feet. The third well in this field has been spotted by Kerr-McGee and will be drilled from the same platform.

Nineteen miles out in the Gulf of Mexico, The Superior Oil Company of California went back into a wildcat it drilled and abandoned in 1947 and reworked it to make a gas-condensate discovery. The well, Gulf of Mexico-State Lease 884, No. 1-A, in Block 71 off Vermillion Parish, had been bottomed at 13,628 feet before abandonment and was then drilled out to 9680 feet and perforated at 9608-18 feet where it tested 53 barrels of 51.4-gravity condensate and 7,024,000 cubic feet of gas per day through a 20/64-inch choke. The derrick has been skidded from this location for another test to be drilled directionally from the platform.

Humble Oil & Refining Company's gas-condensate discovery in Mississippi was not particularly noteworthy from the standpoint of size, but it was the first discovery for the state this year after more than 40 wildcats had been drilled. The company's Ernest Ford No. 3, on the Spring Cottage Prospect about five miles southeast of the Hub field in Marion County, was perforated opposite a sand in the Lower Tuscaloosa at 8997-9002 feet and flowed at the rate of 52 barrels of 58-gravity condensate plus 4,200,000 cubic feet of gas per day through a ¼-inch choke.

A new 14,000-foot oil pay horizon was given to Louisiana by The Texas Company's LLE-Leeville No. 111, which now holds the title of the state's deepest oil producer and is also the company's deepest well. Total depth is 14,473 feet and the well produced initially 391 barrels of 28-gravity through a ⅛-inch choke from perforations at 14,075-87 feet. This new depth champion is located in Lafourche Parish and is 4500 feet southeast of production on the Leeville dome.

Not officially completed at this writing, another new discovery in the open Gulf waters has been made. It is Humble Oil & Refining Company's first strike in this increasingly vigorous marine activity.

New Oil, Distillate and Gas Fields and New Pay Horizons Discovered in the United States in July, 1948

Also Important Extensions to Established Fields

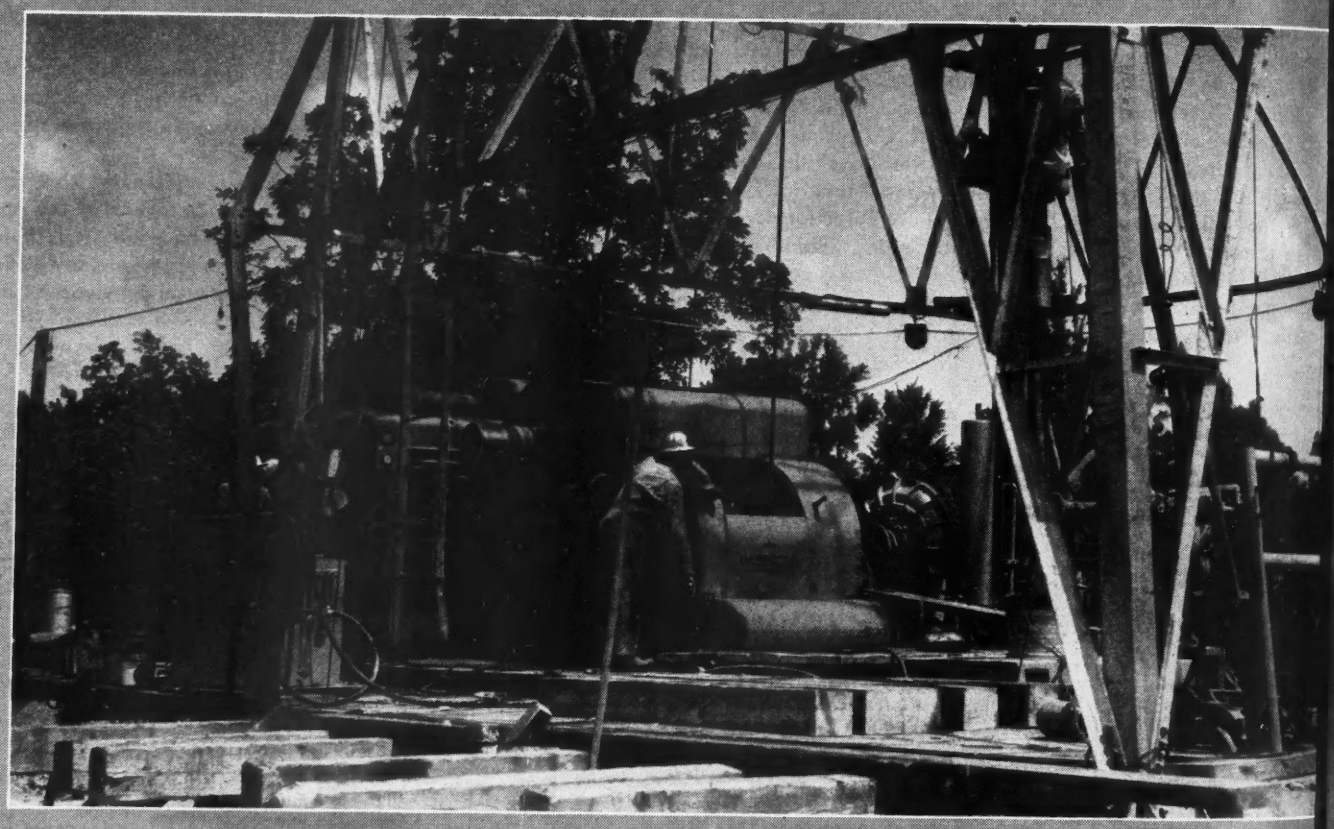
COUNTY	FIELD	COMPANY, WELL AND LOCATION	Date Completed	Total Depth (Feet)	Completion Horizon (Feet)	[1]Name, Character and Age of Producing Formation	[2]Initial Production Method and Choke	Gravity of Oil
		ARKANSAS—New Oil Fields						
Columbia..	College Hill...	McAlester Fuel Co's W. D. Black 1, c nw se 24-15s-21w, 6 mi ne Waldo..	7-24-48	6539	6532- 6535	Smackover li; Jur	P 65; 10 wtr	34.6
Union.....	Cairo.....	Phillips Pet Co's W. B. Scales 1, c ne sw 3-18s-17w, 2½ mi ne Schuler fld..	7-20-48	7878	7760- 7768	Smackover li; Jur	F 312; 11/64"	39.3
		CALIFORNIA—New Oil Field						
Kern.....	Tejon Hills...	Tejon Hills Oil Co's Tejon Hills 2, Sect 10-11n-18w.....	7-24-48	407	380- 407	Sta Margarita sd; Mio	F 45	30.8
		CALIFORNIA—Oil Field Extensions						
Fresno.....	Riverdale.....	R. E. Havenstrite's Larrey 7-14, Sect 14-17s-19e, e extension.....	7- 6-48	7905	7860- 7905	Courtney sd; Eoc	P 100	35
Los Angeles	Whittier.....	Shepard-Pendleton Ltd's Hillside 1, nw¼ Sect 22.....	7- 1-48	1547	.....	Miocene	P 25	15
		COLORADO—New Gas Field						
Montezuma	.....	Byrd-Frost-Western Nat'l & P. B. English's Gov't-Schmidt 1, (OWDD), c sw nw 24-36n-18w, Miceimo Dome.	7- 6-48	7099	6955- 6965	Devonian	50 mln	....
		ILLINOIS—New Oil Fields						
Clay.....	Sailor Springs Cent.	New Pennsylvanian Dev Co's C. O. Schnautz 1, sw ne 31-4n-8e.....	7-31-48	3109	3013- 3051	Rosiclare sd; Miss	P 2; 20 wtr	....
Edwards...	Parkersburg,S.	Bridger Basin's W. Schmidt 1, ne ne sw 8-1n-14w.....	7-31-48	3085	2813- 2828	Bethel sd; Miss	P 36; 7 wtr	....
Madison...	Livingston....	J. L. Neary's C. Henke 1, sw sw sw 17-6n-6w, 9 mi n Marine pl.....	7- 6-48	536	528- 536	Pennsylvania sd; Penn	P 145	....
White.....	Herald, N....	Nat'l Assoc Pet Co's Garrison 1, nw ne ne 24-6s-9e, 1 mi n Herald pl.....	7-13-48	2908	2900- 2908	Aux Vases sd; Miss	P 56; 30 wtr	....
		ILLINOIS—New Oil Pays						
Hamilton..	Belle Prairie..	Phillips Pet Co's Young 1, se ne se 12-4s-6e.....	7-27-48	3425	3253- 3262	Aux Vases sd; Miss	P 44; 2 wtr	....
Wabash....	Maud.....	C. E. Skiles' Schrodt 2-A, sw ne 3-2s-13w.....	7-27-48	2355	1721- 1733	Biehl sd; Penn	P 100	....
White.....	Crossville....	G. Engle's J. Ridenour 2, nw ne se 10-4s-10e.....	7- 6-48	3136	2881- 2890	Bethel sd; Miss	P 40	....
White.....	Grayville, W..	Yingling & W. Duncan's C. Kuykendall 3, ne ne sw 23-3s-10e.....	7-31-48	3266	2992- 3008	Paint Creek sd; Miss	P 60	....
		ILLINOIS—Oil Field Extensions						
Clay.....	Bible Grove Cons.	Baldwin & Pruett's D. L. Marshall 1, nw ne sw 27-5n-7e, ½ mi ext.....	7-31-48	2832	2801- 2819	Aux Vases sd; Miss	P 25; 55 wtr	....
Franklin...	Sesser.....	P. Mosebach's Eurgil 1, se se 35-5s-1e, 1½ mi s extension.....	7-13-48	2768	2586- 2635	Aux Vases sd; Miss	P 50	....
Franklin...	Thompsonville, N	J. M. Sheppard's R. H. Sweet 1, se se ne 9-7s-4e, ½ mi nw extension.....	7- 6-48	3075	3066- 3073	Aux Vases sd; Miss	P 110	....
Gallatin...	Roland.....	C. E. Brehm et al's G. S. Burns 1, se sw sw 20-7s-8e, ½ mi w extension....	7-31-48	2188	2180- 2188	Waltersburg sd; Miss	P 360	....
Richland...	Clay City-Noble Cons.	Arvin Drig et al's A. Hassler 1, se se se 2-3n-8e, 1 mi extension.....	7-13-48	3140	3054- 3058	McClosky li; Miss	P 5; 30 wtr	....
Jasper.....	Dundas, E....	Sohio's K. Robins 1, se se se 14-5n-10e, ½ mi n extension.....	7-27-48	2938	2921- 2933	McClosky li; Miss	P 134	....
Wabash....	Maud, N.....	Phillips & Duncan's Keeps & Pfeister Comm 1, sw sw ne 24-1s-14w, 1 mi sw extension.	7-31-48	2996	2558- 2571	Cypress sd; Miss	P 12; 2 wtr	....
Wabash....	Maud, N.....	L. Roes' L. S. Ankenbrandt 1, se sw 5-1s-13w, ½ mi ne extension.....	7-13-48	2549	2539- 2549	Bethel sd; Miss	P 30	....
Wabash....	Maud, N.....	H. B. Mortimer's M. Peters 1, ne ne nw 19-1s-13w, ½ mi sw extension....	7-13-48	2526	2520- 2526	Cypress sd; Miss	P 15; 5 wtr	....
Wayne.....	Fairfield.....	Nation Oil Co's M. Bothwell 1, se se ne 19-2s-8e, ½ mi sw extension.....	7-13-48	3256	3229- 3248	Aux Vases sd; Miss	P 90	....
Wayne.....	Cisne, N.....	Nat'l Assoc Pet Co's Feller 1, w ne sw 16-1n-7e, ½ mi se extension.....	7-13-48	3250	3047- 3058	Aux Vases sd; Miss	P 42; 4 wtr	....
		INDIANA—New Oil Fields						
Gibson.....	.....	Carter Oil Co's H. M. Montgomery 1, se ne se 18-3s-11w, 2 mi se Owensville	7-16-48	2690	2470- 2478	Rosiclare li; Miss	Sw 67	....
Gibson.....	Rochester....	Olen D. Sharp's T. Berry et al 1, nw sw nw 13-2s-13w, Wabash Twp.....	7- 1-48	2759	1901- 1953	Waltersburg sd; Miss	P 842	....
Posey.....	.....	Cherry-Kidd's Robt Wilson 1, nw ne se 31-5s-13w, Lynn Twp.....	7-13-48	2162	1186- 1196	Mansfield sd; Penn	P 25; 10 wtr	....
Posey.....	.....	G. L. Reasor's Justus 1, ne ne ne 15-6s-12w, Marrs Twp.....	7-30-48	2252	2240- 2252	Cypress sd; Miss	P 105; 100 wtr	....
		INDIANA—Oil Field Extensions						
Posey.....	Bufkin.....	Cherry-Kidd-Ashland's Boberg et al 1, nw ne sw 4-6s-12w.....	7-13-48	2666	2662- 2666	Aux Vases sd; Miss	P 110	....
Posey.....	Griffin, S.....	Geo-Wrather et al's Westheiderman 1, nw nw se 2-4s-14w, ½ mi s ext.....	7-23-48	2887	2864- 2887	Aux Vases sd; Miss	P 140	....
Vanderburgh	Evansville....	Maynard Rogers et al's Herman Ross 1, nw sw sw 36-5s-11w, 1 mi ne ext..	7-30-48	2374	2369- 2374	O'Hara li; Miss	P 35; 30 wtr	....

[1] Character of producing formations abbreviated thus: sh, shale; dolo, dolomite; li, limestone; sd, sandstone; sh, shale; ser, serpentine; cgl, conglomerate. Ages of formations abbreviated thus: Plio, Pliocene; Mio, Miocene; Olig, Oligocene; Eoc, Eocene; U. Cre, Upper Cretaceous; L. Cre, Lower Cretaceous; Jur, Jurassic; Tri, Triassic; Perm, Permian; Penn, Pennsylvanian; U. Miss, Upper Mississippian; L. Miss, Lower Mississippian; Devo, Devonian; Sil, Silurian; Ord, Ordovician; Cam, Cambrian.

[2] Barrels of oil per day (24 hr. rate), flowing (F), pumping (P), swabbing (Sw), or bailing (B); or million cubic feet of gas daily open flow capacity; size of choke given in inches.

"CARDWELL" Model O

—WITH MANUAL CLUTCHES



Cardwell Model O Manual Clutch Rig, owned by Layne Brothers, drilling a 6,000-foot well in the Gulf Coast.

This rugged, hard-hitting "Cardwell" Model O is the ideal draw works for drilling to 6,000 feet. It is a simple, practical machine with a minimum of gadgets. Its field record for drilling well after well without down time is outstanding. Its simplicity guarantees a long life machine with minimum repair costs. Its low first cost and low operating cost means more hole drilled per dollar.

SPECIAL

Manual Clutch Model O

- **Twin Disc Manual Friction Clutches.**
- **Double end drive to drum with jaw clutches in the drum, providing six speeds to Draw Works..**
- **Three speed and reverse heavy-duty Cardwell Chain Transmission.**
- **All wearing parts heat treated.**

Priced as illustrated with Automatic Cathead and Mud Pump Drive less Hydromatic Brake $36,005.00

DIAMOND-HARD BRAKE FLANGES

(550 to 600 Brinnell)—Too Hard To Wear Out, Thus Eliminatin
Unnecessary Replacement Cost, Labor and Down Tim

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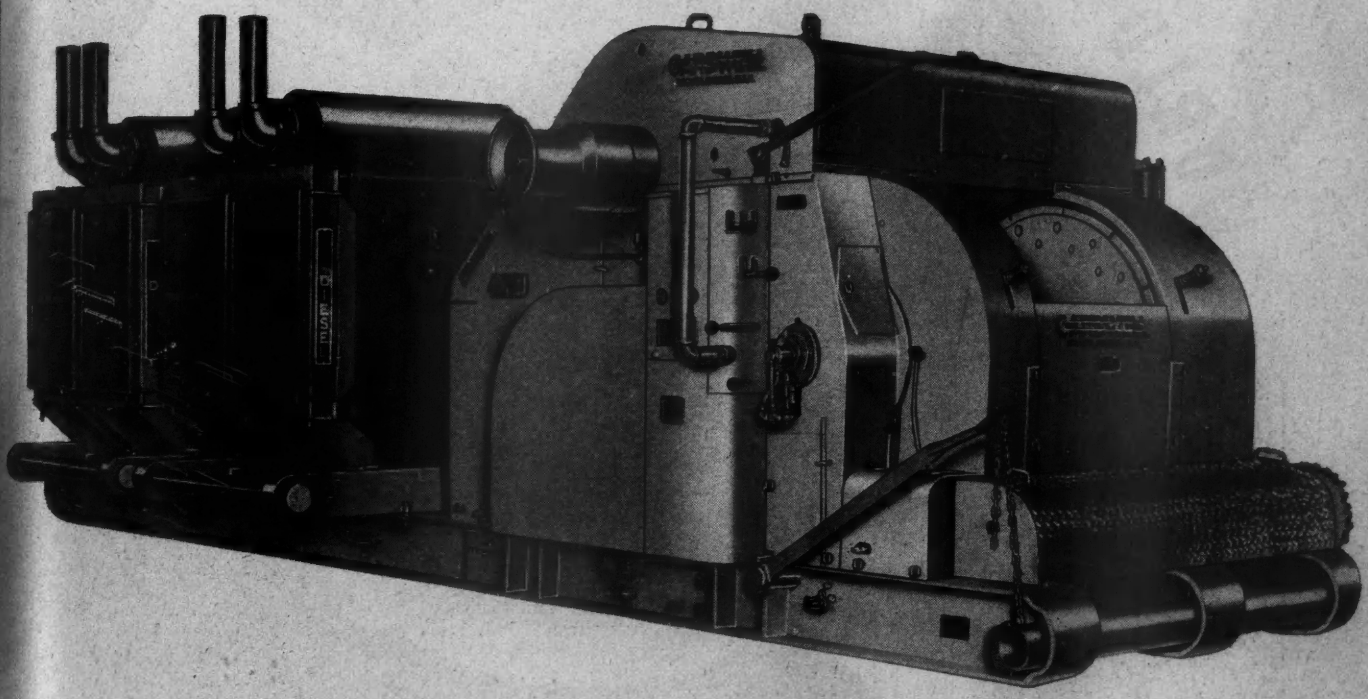
—WITH AIR CLUTCHES



Cardwell Model O Air Clutch Draw Works equipped with General Motors Twin Diesel engines. . . . Note convenience of air controls.

FEATURES

Air Clutch Model O

- Cardwell "Air Disc" Friction Clutches throughout.
- Double end drive to drilling drum with Cardwell "Air Disc" friction clutches IN THE DRUM, providing six speeds to the Draw Works.
- Three speed and reverse heavy-duty Cardwell Chain Transmission.
- All wearing parts heat treated.

This ultra modern Draw Works is equipped with Cardwell "Air Disc" friction clutches throughout, including both ends of the lower drum and one end of upper drum. Powered by two General Motors Twin Diesel Engines, it is recommended for 8,000-foot drilling with 4½-inch drill pipe. Air Clutches in the drums speed operation and eliminate any possible damage from "jumping in" of jaw clutches. Air controlled operation of all clutches makes the driller's job easier, allowing him to concentrate on getting the most hole drilled per day. . . . Both Manual and Air Operated Rigs have the same Cardwell Heavy-Duty, Three-Speed Chain Transmission and many interchangeable parts. . . . The air clutch equipped rig with larger engines is the top performance 8,000-foot rig for your toughest jobs.

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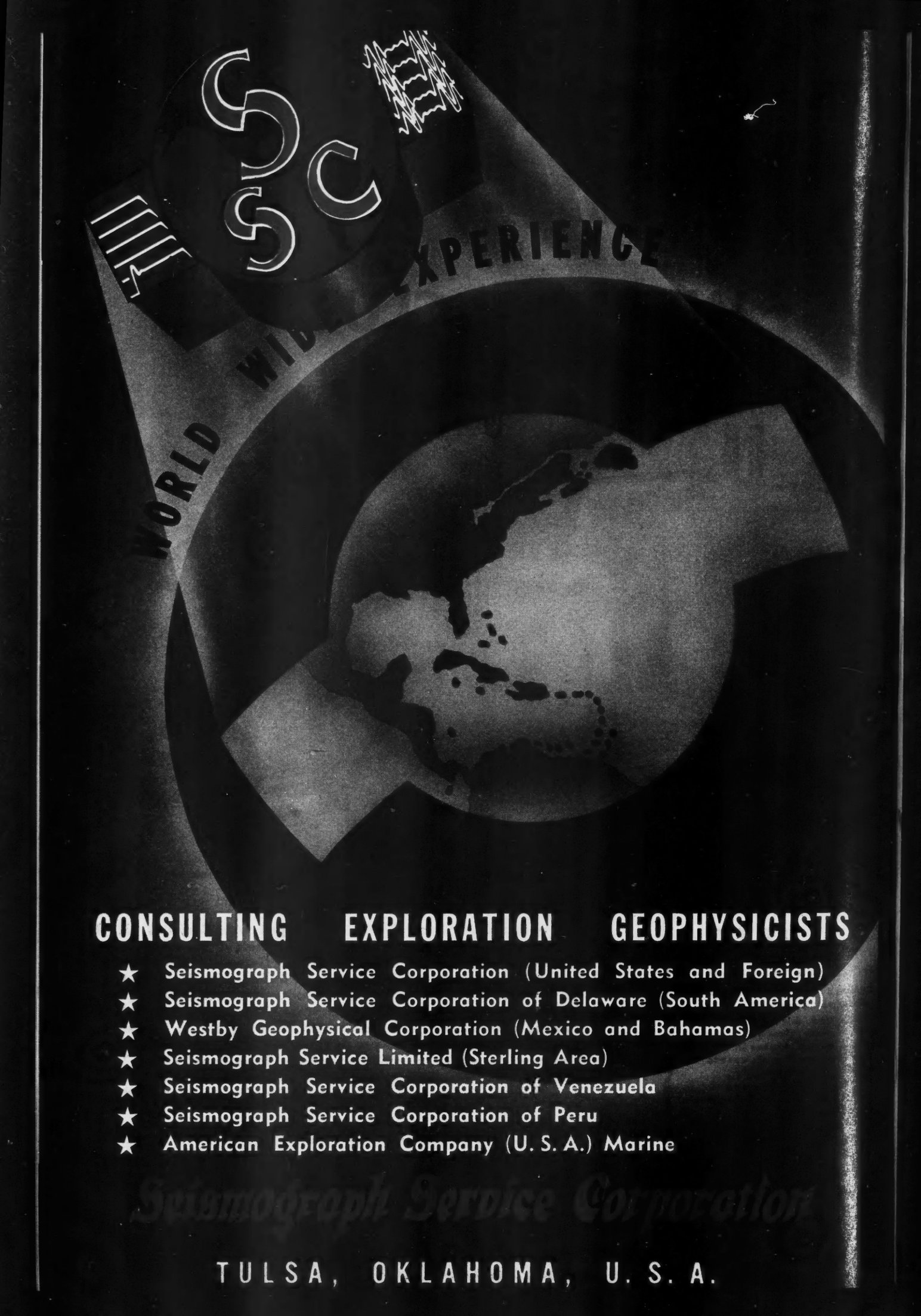

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TULSA, OKLAHOMA, U. S. A.

New Oil, Distillate and Gas Fields and New Pay Horizons Discovered in the United States in July, 1948—Continued

Also Important Extensions to Established Fields

COUNTY	FIELD	COMPANY, WELL AND LOCATION	Date Completed	Total Depth (Feet)	Completion Horizon (Feet)	[1]Name, Character and Age of Producing Formation	[2]Initial Production Method and Choke	Gravity of Oil
		KANSAS—New Oil Fields						
Barton	Yeakley	Sohio et al's Yeakley 1, nw nw nw 17-18s-13w, 1 mi se Eveleigh pl	7-30-48	3324	3317- 3324	Arbuckle li; Ord	P 99	....
Barton	Odin	Palmer Oil Corp's Stump 1, ne ne se 3-17s-12w, 2 mi s Beaver, S. pl	7-13-48	3328	3320- 3326	Arbuckle li; Ord	P 182; 18 wtr	....
Barton	Lake Barton	Texas Co's Trester 1, sw sw sw 21-18s-13w, 4 mi se Eveleigh pl	7-27-48	3389	3371- 3375	Arbuckle li; Ord	P 28	....
Butler		Veeder Supply et al's Hampton 1, se se sw 27-29s-5e, 1½ mi se Coombs pl	7-20-48	2838	2813- 2838	Bartlesville sd; Penn	P 50	42
Rooks	Lone Star	Bay Pet Corp's Hunter 1, sw sw sw 4-9s-17w, 4 mi sw Stockton pl	7-13-48	3399	3382- 3386	Arbuckle li; Ord	P 80; 60 wtr	....
		KANSAS—New Gas Field						
Stafford	Bradbridge	Cromwell & Lewis Bradbridge 1, sw sw sw 6-24s-15w, 3 mi nw O'Connor pl	7-13-48	4024	4017- 4024	Arbuckle li; Ord	4.4 mln	....
		KENTUCKY—New Oil Fields						
Ohio		F. H. Rhodes' Perene Rice 1-A, 3-N-34, 2½ mi ne Fordsville	7-16-48	658	653- 658	Aux Vases li; Miss	P 15; 10 wtr	....
McLean		Benedum-Trees-T. Galey's McManama 1, nw nw sw 22-L-28, 4 mi sw Island	7-23-48	1889	1872- 1889	Bethel sd; Miss	P 15; 15 wtr	....
Webster	Dixon	Ft. Shelton-Ashland et al Mattie Ramsey 1, se ne sw 21-M-22, Lot 6, 1 mi se Dixon.	7-30-48	3047	3040- 3047	O'Hara li; Miss	P 26	....
		NORTH LOUISIANA—New Oil Fields						
Natchitoches	Gorum	Victor P. Grage's W. D. Ambrose et al 1, Sect 10-5n-6w, 1 mi w Gorum	7-26-48	6802	5792- 5795	Wilcox sd; Eoc	F 45; 4/64"	44.8
Union	Truxno	Newton Oil Corp's Nale 1, c nw nw 30-23n-1e, 4 mi sw Laram	7- 3-48	2249	2208- 2214	Nacatoch sd; Cre	F 97; 146 wtr; ¼"	35.6
		NORTH LOUISIANA—Oil Field Extension						
La Salle	Saline Bayou	Hunt Oil Co et al's La. Delta Hardwood Lbr 2, Sect 1-4n-4e, ¾ mi sw ext.	7-29-48	10050	5560- 5570	Wilcox sd; Eoc	F 475; 4/64"	46
		NORTH LOUISIANA—Gas Field Extension						
Bienville	Bear Creek	C. H. Murphy & Co's Advance 1, Sect 8-16n-5w, 1 mi e extension	7-31-48	8004	7126- 7154	Pettit li; L Cre	11.5 mln; open	....
		SOUTH LOUISIANA—New Oil Pays						
La Fourche	Leeville	Texas Co's LLE-Leeville 111, Sect 2-22s-22e, 4500 se extension	7-26-48	14473	14075-14078		F 391; 16/64"	28
St. Charles	Bayou Couba	Gulf Ref Co's Delta Sec Co Inc 28, Sect 18-15s-22e	7- 1-48	8234	3799- 3803		F 168; 4/64"	29.5
St. Mary	W. Cote Blanche Bay	Texas Co's State-W. Cote Blanche Bay Lse 340-37, Twp 15s-6e	7- 7-48	3153	2364- 2370		F 32; 11/64"	20.7
Terrebonne	Block 32	Kerr-McGee Oil Ind Inc's State-Ship Shoal 2-32, Blk 32	7-13-48	3238	2809- 2824		F 700; 11/64"	27.7
		SOUTH LOUISIANA—Oil Field Extension						
Beauregard	Bivens	Atlantic Ref Co's Newport Industries Inc 1-C, Sect 7-5s-11w, 1 mi e ext	6-23-48	7775	7260- 7267		F 132; 16/64"	42.1
		SOUTH LOUISIANA—New Distillate Fields						
Beauregard	Gordon, N.	Barnsdall Oil Co's Edgewood 2, ne¼ Sect 14-6s-10w, 2 mi sw Longville fld	6-13-48	9300	8458- 8463		F 146; 1.5 mln; 11/64"	59
Vermilion		Superior Oil Co's Gulf of Mexico-State Lse 884, A-1 (OWWO), Blk 71	7- 1-48	13628	9608- 9618		F 53; 7 mln; 4/64"	51.4
		SOUTH LOUISIANA—New Distillate Pays						
Acadia	Tepetate, N.	Atlantic Ref Co's C&R Klumpp B-5, Sect 13-7s-2w	7-15-48	8168	7415- 7417		F 97; 5.2 mln; 4/64"	42.5
Iberville	St. Gabriel	Gravis & Mitchell's Mary Walker Goston 1, Sect 7-9s-2e	7-12-48	11625	11015-11045		F 492; 1.8 mln; 4/64"	52
Jeff Davis	Mermentau, W.	Roeser & Pendleton's Johnson-Boudreaux 1, Sect 17-10s-2w	7- 1-48	10326	8264- 8270		F 80; 2.2 mln; 4/64"	60
St. Charles	Paradis	Texas Co's Sunset Rlty & Pltg Co 20, Sect 39-14s-20e	7-20-48	13760	11042- 11102		F 48; 1.6 mln; 4/64"	51.8
		MICHIGAN—New Oil Fields						
Allegan		J. W. Lang Co's Boyce 1, ne ne ne 14-3n-14w, Heath Twp	7-16-48	1523	1520- 1523	Traverse li; Devo	P 100	....
Mason	Eden	Superior Oil Co's Bertram W. Sippy et al 1, se se ne 26-17n-16w, Eden Twp	7-30-48	1682	1677- 1682	Traverse li; Devo	F 720	34.5
Osceola		Gulf Ref Co's State-Sylvan 1, nw se sw 9-18n-7w, Sylvan Twp	7-30-48	3940	3928- 3938	Dundee li; Devo	F 720	....
		MISSISSIPPI—New Distillate Field						
Marion		Humble's Ernest Ford et al 2, Sect 13-1n-18w, 5 mi se Hub fld	7-16-48	10696	8997- 9002	L Tuscaloosa sd; Cre	F 53; 4.4 mln; ¼"	53
		MONTANA—New Oil Field						
Musselshell		Texas Co's Northern Pacific 1-B, se ne nw 19-10n-27e, Big Wall area	7- 1-48	3139	3093- 3105	Kibbey sd; Miss	P 20	32.7
		OHIO—New Gas Field						
Morgan		Wittmer Co's Wm O. Wortman 1, Sect 24 Bristol Twp, 9 mi e Brush Crk fld	7-15-48	4900	4807- 4810 4840- 4845	Shell li; Sil Clinton sd; Sil	1 mln	....
		OKLAHOMA—New Oil Fields						
Garvin		Phillips Pet Co's Hillman 1, nw sw sw 3-2n-2w	7-29-48	7145	6550- 6575	Gibson sd; Penn	F 108; 4/64"	42.7
Lincoln		J. F. Smith's Jones 1, nw nw se 35-12n-3e	7-22-48	5014	4938- 4947		P 24	....
Logan		Barney Fengin's Wesley Noble 1, se se sw 20-16n-3w	7-15-48	6301	5760- 5772	Red Fork sd; Penn	F 153; 4/64"	42
Noble		B. B. Blair's Rolling 1, ne ne nw 9-22n-1w	7- 9-48	4603	4558	Bartlesville sd; Penn	F 150; 4/64"	....
Payne		Republic Nat Gas Co's Lovell Bros Tr 1, sw sw nw 35-18n-3e	7-15-48	3950	3939- 3945	Bartlesville sd; Penn	F 10; 20 wtr	....
Pontotoc		J. C. Jaques' Myers "B" 1, sw nw sw 10-5n-6e	7-29-48	1726	1702- 1717	Pennsylvania sd; Penn	P 10	37
		OKLAHOMA—New Oil Pays						
Noble	Perry, NW	Carter Oil Co's E. Vertz 1, se nw sw 8-21n-1w	7-22-48	5210	5204- 5210	Marshall sd; Penn	F 260; 5/64"	40.3
Okfuskee	Sheldon	Ralph Fillmore's Deaner 1, sw se sw 15-12n-11e	7-29-48	3490	3474- 3490	Wilcox sd; Ord	F 300; ¼"	45
		OKLAHOMA—New Gas Fields						
Cotton		E. G. Whisnand's State 1-A, ne sw nw se, 16-2s-11w	7- 9-48	1973	1966- 1973	Pontotoc sd; Penn	5 mln	....
Hughes		Pure Oil Co's G. G. Derrick 1, ne ne nw 32-6n-11e	7-30-48	6700	4866- 5100	Cromwell sd; Penn	3 mln	....
Okfuskee		Skelly Oil Co's Bombarger 1, (OWWO), sw ne se 12-13n-7e	7-22-48	3510	3485- 3509	Dutcher sd; Penn	1.6 mln	....
		TEXAS—District 2 (MIDDLE GULF COAST)—New Oil Pay						
DeWitt	Cottonwood Creek	Pan American Prod Co's Paul Lang 1, Luke N. Mason & John F. Kemper Sur.	7-15-48	7784	7625- 7626	Massive sd; Eoc	F 35; 4/64"	35.6
		TEXAS—District 2 (MIDDLE GULF COAST)—New Gas Field						
Victoria		Danciger O&R Co's J. W. Bass 1, Blk 18, Fleming Rch Subd. F. G. Hidalgo Gr, 1 mi s Coletto Crk fld.	7-10-48	5188	4618- 4620		38.9 mln; open	....
		TEXAS—District 2 (MIDDLE GULF COAST)—New Gas Pays						
Refugio	Refugio-Fox	Union Prod Co's Mary F. Lambert A-7, T. C. Lambert & W. H. Allen Sur.	7- 1-47	7010	1720- 1725		10.4 mnl; open	....
Victoria	Ines, S.	Cities Service's Mrs. S. H. Baker 2, Blk 56, Allison-Richey Ld Co Subd of Roseborough Rch.	6-24-48	6259	5116- 5130		93 mln; open	....
		TEXAS—District 3 (UPPER GULF COAST)—New Oil Field						
Orange	Orange, N.	Placid Oil Co's Wm. Winfree 1, 850 fr nl 660 fr el 98.8-ac Lse, C. West Sur.	8- 1-48	8095	7710- 7715	L Frio sd; Olig	F 321; 4/64"	42
		TEXAS—District 3 (UPPER GULF COAST)—New Oil Pays						
Brazoria	W. Columbia	Texas Co's J. G. Phillips et al 32, Geo. Tennille Lge	7-20-48	7331	6676- 6706		F 162; ¼"	28
Hardin	Beech Creek	American Republics Corp's Fortenberry Fee-Sect 188-1, W. W. Fortenberry Sur.	7-27-48	7088	6728- 6730		F 155; 5/8"	41.6
Harris	Hockley Dome	Magnolia's Warren Ranch 7, H&TB Sur 1	7-17-48	3725	3063- 3066		F 168; 4/64"	25.6
Harris	Clinton, E.	F. M. Corselius' J. J. Oates 1, Reels & Trobough Sur	7-27-48	7503	6541- 6550		F 156; 5/8"	37.5
		TEXAS—District 3 (UPPER GULF COAST)—New Distillate Pays						
Harris	N. Delhi	Cities Service's David Rorick 1, Sect 48, H&TC Sur, Blk 2	6-16-48	7604	7252- 7263	"T" sd; Eoc	F 31; 1.4 mln; 4/64"	53.8
Orange	Pt. Neches, N.	Gulf Oil Corp's J. D. & O. J. Todd Jr., 1, Jas. V. Polk Sur	6-19-48	8704	8420- 8450		F 165; 6.3 mln; ¼"	57
		TEXAS—District 3 (UPPER GULF COAST)—New Gas Fields						
Brazoria	W. Columbia, SW.	Hogg Oil Co's T. M. Smith et al 1, J. H. Bell Sur, 1200 off sw flank of dome	7-16-48	4740	3710- 3724		1.8 mln; ¼"	....
Wharton		Lloyd Smith & McKay Donkin's Joe Mach 1, nw¼ Sect 25, ETRR Sur, 3 mi se El Campo.	7-22-48	7132	6775- 6834	Frio sd; Olig	3.2 mln; ¼"	....

[1] Character of producing formations abbreviated thus: ch, chalk; dolo, dolomite; li, limestone; sd, sandstone; sh, shale; sur, serpentine; cgl, conglomerate. Ages of formations abbreviated thus: Plio, Pliocene; Mio, Miocene; Olig, Oligocene; Eoc, Eocene; U. Cre, Upper Cretaceous; L. Cre, Lower Cretaceous; Jur, Jurassic; Tri, Triassic; Perm, Permian; Penn, Pennsylvanian; U. Miss, Upper Mississippian; L. Miss, Lower Mississippian; Devo, Devonian; Sil, Silurian; Ord, Ordovician; Cam, Cambrian.

[2] Barrels of oil per day (24 hr. rate), flowing (F), pumping (P), swabbing (Sw), or bailing (B); or million cubic feet of gas daily open flow capacity; size of choke given in inches.

New Oil, Distillate and Gas Fields and New Pay Horizons Discovered in the United States in July, 1948—Continued

Also Important Extensions to Established Fields

COUNTY	FIELD	COMPANY, WELL AND LOCATION	Date Completed	Total Depth (Feet)	Completion Horizon (Feet)	[1]Name, Character and Age of Producing Formation	[2]Initial Production Method and Choke	Gravity of Oil
		TEXAS—District 3 (UPPER GULF COAST)—New Gas Pay						
Jefferson	Winnie	Al Brown et al's Edwin L. Stephen 1, Lot 84, Francisco Valmore Lge	7- 2-48	7816	5462- 5468	Miocene	1.8 mln; 4/16"	....
		TEXAS—District 4 (LOWER GULF-S.W.)—New Oil Fields						
Aransas		Sullivan & Garnett's Geo. E. Shelly et al 1, Tr 2 of Reserve "D" Sur, Lamar Peninsular.	7-10-48	7625	7286- 7296	L Marginulina sd	F 30; 8/64"	38
Hidalgo	Arrowhead	Sun's Bentsen Bros. 1, 2500 fr el 1980 fr sl Sect 3, G. O. Newman Subd	7- 4-48	9120	5967- 5969		F 44; 11/64"	47
		TEXAS—District 4 (LOWER GULF-S.W.)—New Oil Pays						
Jim Wells	La Gloria	Magnolia's H. B. Barrera 1, Lot 5, Blk 5, Lds adj La Gloria Twst	7-18-48	7800	7563- 7568	Barrera sd; Olig	F 115; 7/32"	40
Nueces	Farenthold	Southern Minerals Corp's Richard King D-4, Blk 6, Richard King Frm Lots	7-19-48	6141	5760- 5766		F 62; 1/2"	48.4
					6123- 6131		F 150; 1/2"	43.8
San Patricio	White Pt., E.	Stanolind's J. A. Teeter 2, Sect 50, Geo. H. Paul Subd	7-11-48	6803	3337- 3340		F 104; 5/32"	20.8
		TEXAS—District 4 (LOWER GULF-S.W.)—New Distillate Fields						
Starr	El Panal	Sunray Oil Corp's T. B. Slick Est 1, El Panal Gr, 3½ mi e Rincon fld	7-20-48	6005	4671- 4679		2.2 mln; open	....
San Patricio		F. M. Boykin Jr's C. V. Jones A-1 (OWDD), ne¼ Sect 67, Geo. H. Paul Subd Coleman Fulton Pastr Co. Lds.	6- 7-48	7506	6578- 6586		F 288; 9 mln; open	64
		TEXAS—District 5 (EAST CENTRAL)—New Oil Fields						
Hopkins		Shell's J. L. Hedrick 1, Geo. B. Halyard Sur, 6 mi se Sulphur Bluff	7-30-48	4800	4525- 4550	Paluxy sd; L Cre	P 119	14.3
Kaufman		Thos. D. Humphrey's Annie Mae Tuggle et al 1, E. D. Fitzgerald Sur, 4 mi se Kemp.	7-20-48	6996	6106- 6142	Bacon li; L Cre	P 69; 5 wtr	38.8
		TEXAS—District 6 (NORTHEAST)—New Oil Field						
Shelby	Patroon	Humble's Pickering Lbr Corp 1-C, James Rowe Sur, 2 mi ne Patroon	7- 8-48	5328	5272- 5328	U Glen Rose li; L Cre	F 109; ¼"	31.2
		TEXAS—District 7-B (NORTH CENTRAL)—New Oil Fields						
Brown		Bishop & Richker's J. Joplin 1, B. R. Bragg Sur 559, 2 mi nw Brownwood	7- 1-48	2151	1620- 1750	Caddo li; Penn	P 16; 5 wtr	38
Callahan		Ungren & Frazier et al's W. E. Milliorn 1, sw¼ Sect 20, BBB&CRR Sur	7-13-48	1330	1322- 1330		F 204; 1/2"	38.7
Haskell		British-American's A. A. Smith 1 (OWWO), J. Colston Sur, 5 mi ne Weinert	7-18-48	5712	5315- 5337		P 46; 20 wtr	34.4
Jones		S. B. Roberts et al's Roy E. Prichard 1, G. Martinez Sur, 2¼ mi n Hawley	7-23-48	2575	2082- 2095		P 118	37
Stephens		Fred M. Manning Inc's W. T. Moore "B" 3, s½ Sect 2256, TE&L Sur	7-14-48	3378	3319- 3324	Caddo li; Penn	F 150; 7/32"	41
		TEXAS—District 7-B (NORTH CENTRAL)—New Oil Pay						
Callahan	Callahan Co. Reg.	Anderson Prichard's Tom Windham "A" 1, se¼ Sect 369, Geo. Hancock Sur, 3 mi ne Oplin.	7- 3-48	4423	4348- 4364	Ellenburger dolo; Ord	F 192; ½"	40
		TEXAS—District 7-B (NORTH CENTRAL)—Oil Field Extensions						
Throckmorton	Manning-Parrott	Leiter & Duffield's J. C. Odom 1, Sect 964, TE&L Sur, ¾ mi s ext	7-24-48	2570	2525- 2570	Strawn sd; Penn	P 87	41
Wise	Chico	Cities Service's Sealy 1, Sect 3, GH&H Sur, 1½ mi nw extension	7-24-48	5395	5306- 5340	Bend cgl; Penn	F 621; 5/32"	41.4
		TEXAS—District 7-B (NORTH CENTRAL)—New Gas Field						
Stephens		Andrews et al's M. Duncan 1, Lot 4, Ruthy Campbell Sur, 4 mi ne Ivan	7-19-48	4071	4061- 4071	Caddo li; Penn	14.3 mln	....
		TEXAS—District 7-C (WEST CENTRAL)—New Oil Fields						
Coke		Alan Guiberson's Jack Lassiter 1, Sect 308, Blk 1-A, H&TC Sur, 3 mi nw Sanco.	7- 1-48	6528	6510- 6517	Marble Falls li; Penn	F 222; 32/64"	46.7
Runnels		E. S. Price's Claude Brookshier 1, J. H. Parramore Sur 136, 5 mi ne Benoit	7-20-48	3750	3747- 3750	Morrow sd; Penn	F 203; 4/16"	37
		TEXAS—District 7-C (WEST CENTRAL)—Oil Field Extension						
Coke	Jameson	Sun's W. I. Tubb-Omega 1, Mrs. A. E. Wiley Sur 2	7-26-48	6497	6453- 6497	Reef li; Penn	F 159; ¼"	48.7
		TEXAS—District 8 (WEST)—New Oil Fields						
Andrews	Shafter Lake-Clear Fork	Phillips Pet Co et al's Texas-Univ. 1-T, Blk 13, Univ. Lds Sur	7- 1-48	11000	6910- 6950	Clear Fork dolo; Perm	P 26; 7 wtr	34
Andrews	Fullerton-Wichita Albany	Mid-Continent Univ. 9-9, Sect 19, Blk 13, Univ. Lds	7- 9-48	7968	7890- 7925	Wichita Albany dolo; Perm	F 482; ¼"	44
Cochran		C. U. Bay's Ralph Gardner 15-1, Lge 131, F. O. Subd 2, Carson CSL Sur, 5 mi se Lehman.	7-17-48	5010	4970- 5010	San Andres li; Perm	P 88	30.8
Cochran		Anderson-Prichard's Dorothy L. Slaughter et al 1, Lge 114, Potter CSL Sur. 4½ mi s Lehman.	7- 8-48	4960	4849- 4927	San Andres li; Perm	P 65; 28 wtr	27
Crane		Geo. F. Getty's Mollie Day 1, Sect 3 Blk X, CCSD&RGNG Sur, 2½ mi s Crane.	6-24-48	3179	2705- 2820	Grayburg dolo; Perm	P 72	30.6
Ector		Stanolind's E. F. Cowden "D" 1, Sect 40, Blk 43, T-2-S, T&P Sur, ¾ mi sw Addis Deep pl.	7-22-48	9235	9205- 9224	Canyon li; Penn	F 202	39
Gaines		Cities Service & Atlantic Ref Co's Proctor 1, Sect 355, Blk G, CCSD&RGNG Sur, 5½ mi w Seminole pl.	7- 1-48	5352	5030- 5142	San Andres li; Perm	F 411; 11/2"	34.4
Hockley		Geo. P. Livermore Inc's Dewitt Estate 1, Lab 6, Lge 29, Rusk CSL, 2 mi s Levelland.	7- 7-48	4957	4843- 4845	San Andres li; Perm	P 128	31
Reeves	"Chapman"	Ford Chapman's Standard of Texas-Randolph 1, Sect 46, Blk 57, T-2, T&P Sur, 3½ mi sw Orla.	7- 1-48	2906	2900- 2906	Deleware sd; Perm	P 214	42
Scurry	"Schattel"	Sun & Humble's Emil Schattell 1, Sect 186, Blk 97, H&TC Sur, 7 mi sw Snyder.	7-16-48	6891	6812- 6858	Canyon li; Penn	F 480; ½"	44
Sterling		Plymouth Oil Co's Georgia Frost 1, Sect 39, Blk 2, H&TC Sur, 1½ mi n Iolanthe.	7-24-48	8444	8200- 8210	Strawn sd; Penn	P 8; 57 wtr	45.9
		TEXAS—District 8 (WEST)—Oil Field Extensions						
Andrews	Shafter Lake	Continental's Univ. 1-C-25, Sect 25, Blk 14, Univ. Lds Subd, 3 mi n ext	5-28-48	4770	4750- 4770	San Andres li; Perm	P 5	32
Floyd	Arick	Robert Donnell's E. M. Carmichael 1, Sect 18, Blk K, TTRR Sur, ½ mi e extension.	7-12-48	6055	5855- 5906	Canyon li; Penn	P 406	42.3
Hockley	Levelland	Tide Water's F. B. Young 1, Lab 2, Lge 30, Baylor CSL, se extension	7- 7-48	4850	4790-		P 73	30.1
Pecos	Ft. Stockton	Phillips Pet Co's Caleb 1, Sect 1, Blk 114, CG&SF Sur	7-25-48	2896	2750- 2869	Yates sd; Perm	F 22; ¼"	34.3
Pecos	White & Baker	Helmerich & Payne Inc's Lowery & Wilson "D" 3, Sect 46, Blk Z, TCRR Sur, n extension.	7- 8-48	1899	1884- 1899	Brown li; Perm	F 46; ¼"	31.4
		TEXAS—District 9 (NORTH)—New Oil Fields						
Archer		J. J. Lynn's Jack Neale 1, Sect 2, BS&F Sur, 2 mi ne Olney	7-28-48	5208	5198- 5208	Mississippi li; Miss	F 144; 11/64"	47
Clay		Grace & Grace's Mae Fields Greer 1, Grayson CSL, 1 mi n Blue Grove	7-30-48	6792	5722- 5752	Caddo li; Penn	F 25; ¼"	43
Montague		Continental's S. W. Kennedy 1, n½ of nw¼ Sect 27, ETRR Sur, 2 mi sw Magee fld.	7-22-48	6626	6180- 6265	Caddo li; Penn	F 450; ½"	42
Wilbarger		National Assoc Pet Co's E. Davis 1, ne¼ Sect 3, Blk 10, H&TC Sur, 1 mi s Odell.	7- 7-48	6805	4741- 4775	Palo Pinto li; Penn	F 177; ¼"	....
Wichita		Continental's Hausler Bros 1, J. Pike Sur, 1 mi ne Wichita Falls	7-14-48	6008	5686- 5698	Simpson sd; Ord	P 181	45
Young		Allar Co's Watson Hrs 1, J. Saunders Sur, 4½ mi se Murray	7-14-48	2617	2615- 2617		F 145; ½"	38
Young		Warren Oil Corp's R. T. Sweeney 1, 2379 TE&L Sur, 3 mi n Walsh fld	7-23-48	4311	4305- 4311	Bend cgl; Penn	F 252; ½"	42
Young	"Garvey-Strawn"	H. D. Egger's B. W. King 1, Nicholson Sur, 1 mi se Farmer	7-15-48	4288	2922- 2932	Strawn sd; Penn	F 481; ¼"	....
		TEXAS—District 9 (NORTH)—New Oil Pays						
Wichita	Wichita Co Reg	Fain & McGaha's Parker Hrs 1, Blk 24, Palo Pinto CSL	7-10-48	5072	5060- 5072	Conglomerate	F 576; ¾"	45
Young	Walsh	Cities Service's T. L. Mayer 3, Sect 2373, TE&L Sur	7-15-48	4292	3750-	Caddo li; Penn	F 320; 4/16"	41.1
		TEXAS—District 9 (NORTH)—Oil Field Extension						
Archer		G. E. Kadane & Sons et al's Perkins et al "AA" 1, C. Keith Sur, 1 mi w ext.	7-24-48	577	573- 577		P 20	39
		UTAH—New Gas Field						
San Juan		Western Nat Gas Co et al's English-Tribal 1, Boundary Butte area, c ne nw 22-43s-22e.	6-10-48	6090	4620- 4670	Hermosa li; Penn	20 mln	....
		WYOMING—New Oil Fields						
Johnson		Continental's Coles 1, nw nw se 17-42n-78w, 10 mi n Salt Creek fld	7-10-48	7726	7697- 7705	Lakota sd; L Cre	F 241; ¼"	39.3
Big Horn		Sohio & Barnsdall's Gov't-Fox 1, c se sw 6-57n-97w, Sage Creek Unit	7- 6-48	3450	3428- 3445	Madison li; Miss	F 360; ¼"	....
		WYOMING—New Oil Pay						
Niobrara	Little Buck Creek	Continental's Bowman 8, (ELCU-B 12), nw ne se 26-36n 64w	7-30-48	5254	5216- 5254	Converse	Sw 336	35.8
		WYOMING—Oil Field Extensions						
Fremont	Pilot Butte	Brinkerhoff Drlg Co's Heslin 1, nw sw se 15-3n-1w, ½ mi ne extension	7-23-48	6298	6275- 6298	Tensleep sd; Penn	P 432	26

[1] Character of producing formations abbreviated thus: ch, chalk; dolo, dolomite; li, limestone; sd, sandstone; sh, shale; sur, serpentine; cgl, conglomerate. Ages of formations abbreviated thus: Plio, Pliocene; Mio, Miocene; Olig, Oligocene; Eoc, Eocene; U. Cre, Upper Cretaceous; L. Cre, Lower Cretaceous; Jur, Jurassic; Tri, Triassic; Perm, Permian; Penn, Pennsylvanian; U. Miss, Upper Mississippian; L. Miss, Lower Mississippian; Devo, Devonian; Sil, Silurian; Ord, Ordovician; Cam, Cambrian.

[2] Barrels of oil per day (24 hr. rate), flowing (F), pumping (P), swabbing (Sw), or bailing (B); or million cubic feet of gas daily open flow capacity; size of choke given in inches.

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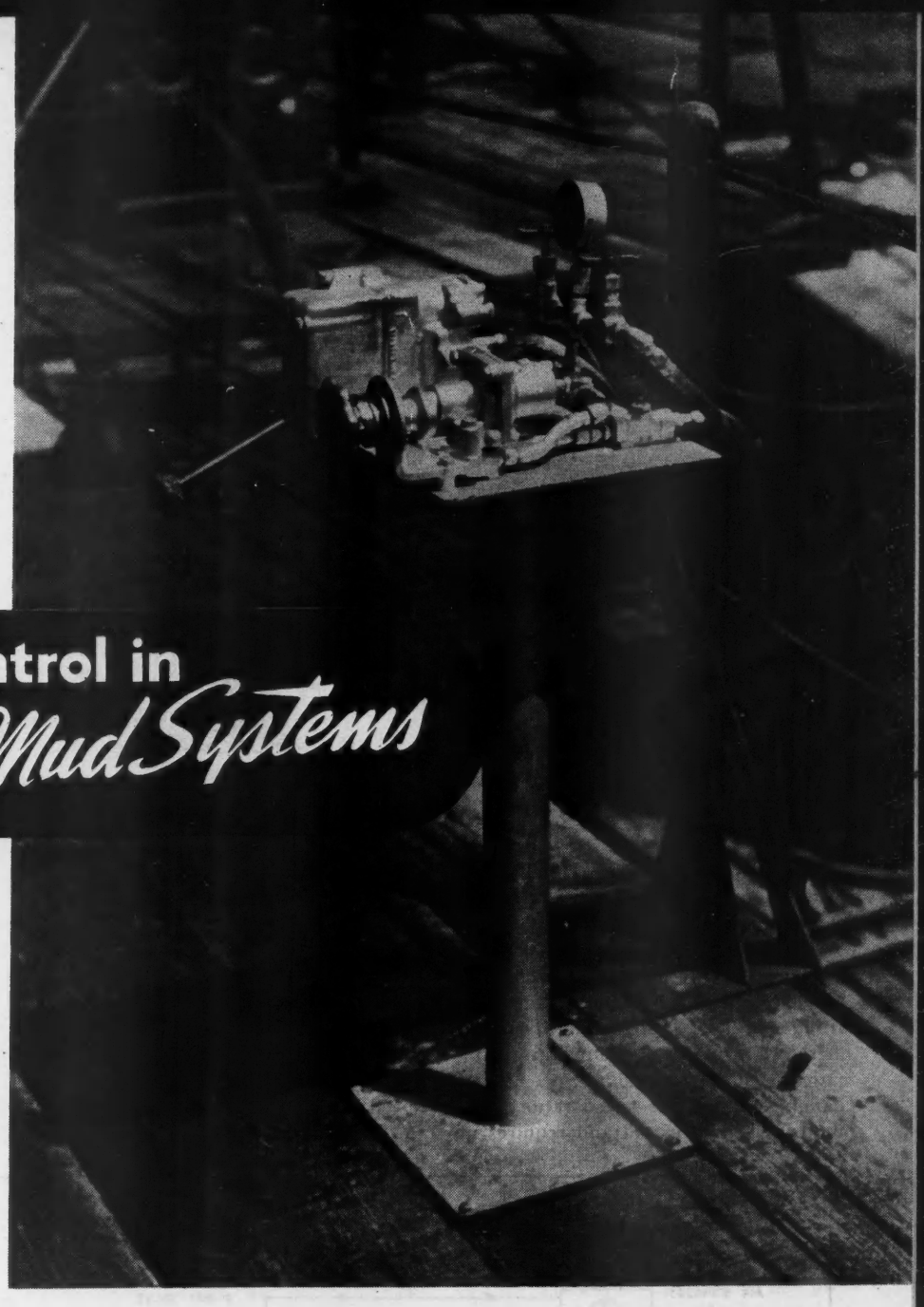
By J. E. KASTROP
Staff Writer

Pneumatic Control in *Drilling Mud Systems*

COMPRESSED AIR is continually finding wider application on modern rotary drilling rigs as a medium through which strenuous tasks are being simplified, while at the same time providing extremely close control over equipment operation. Here is a pneumatic device that is quite effective in the control over the mud system.



Main air control valve, idling speed control valve, double-check valve, gauges, etc., are mounted on a pedestal which is bolted to the floor on the drilling engine platform. From this position, the operator may gain full view of both mud pumps and the bypass valve.

STARTING and stopping heavy-duty steam-driven mud pumps and diverting the flow of mud from the standpipe back into the slush pit can now be accomplished by a mere twist of the wrist. These controlling valves can be located remotely from the pumps at any convenient point on the derrick floor or drilling engine platform. An ingenious application of compressed air performs these jobs easily and safely. The Petroleum Engineering Division of the Humble Oil & Refining Company sponsored the design and fabrication of these remote controls for the mud pump steam throttles and automatic standpipe bypass.

Air, compressed to 100 pounds per square inch, is applied to regulate the speed of both mud pumps simultaneously or individually, to bypass automatically the flow of drilling fluid during stand changes, to retrieve wire line core barrels, or for other operations which require relatively short down time. It has been estimated that during average drilling to make hole, one hour out of every eight is required to start and stop the mud pumps when adding a new joint of pipe to the drill string. During the time the pumps are shut down, it is possible that their prime will be lost and considerable time will be consumed in picking up suction. It is extremely important when drilling deep wells in known high-pressure areas that the mud pumps do not lose their prime. When drilling is momentarily interrupted to add a joint of drill pipe to the drill string, the automatic bypass stops the flow of mud to the standpipe and carries the fluid back to the slush pipe, making it unnecessary to shut the pumps down.

The automatic bypass completely syphons mud from the standpipe and rotary hose, thereby eliminating a "wet" joint when breaking out the kelly to pick up a new joint of pipe. The volume of mud lost over the floor in this manner is thus minimized and the job of adding another joint of pipe to the string is made less hazardous.

Maintaining prime of both mud pumps during short-interval down time is ex-

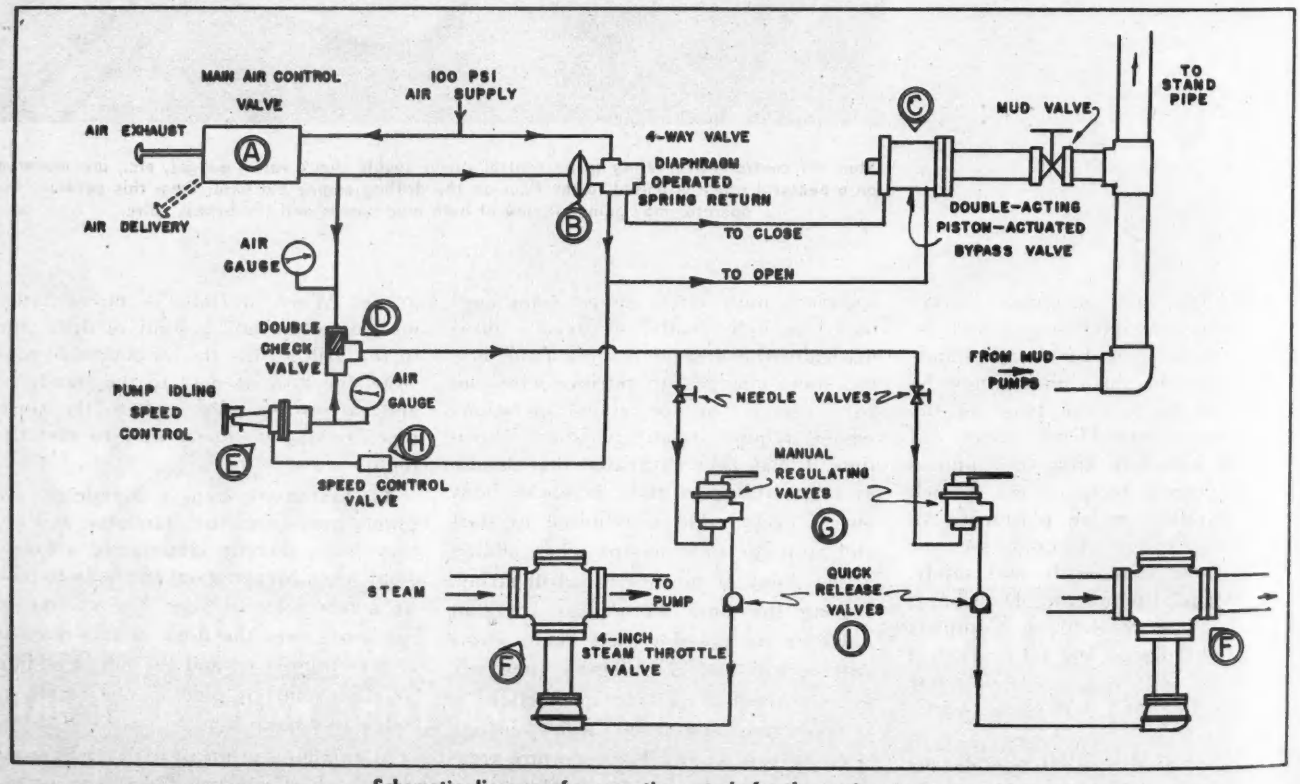
The double-acting, piston-actuated bypass valve in the open position and discharging mud back into the slush pit. The mud is diverted from the standpipe in order to keep pumps at idling speed thereby maintaining prime on the pump suctions. The valve is controlled by air pressure.

tremely important when these pumps are compounded or when they are electrically driven or powered by internal combustion engines. The air controls maintain a corresponding speed ratio of one compounded pump to the other throughout their speed range control. Therefore, when the pumps are automatically slowed to idling speed when changing stands, the speed ratio of the pumps is kept constant and requires no readjustment. This point is also an advantage when the pumps are operated in parallel.

Secondary accomplishments of these developments, which are none the less important, have been the reduction of physical effort formerly required to start and stop the mud pumps, the attainment of smoother control over pump speed, and an added measure of safety in drilling operations. These sensitive pneumatic devices provide instant control over the steam-powered mud pumps and make it possible to exert this control from a remote position, such as from the engine platform where a general view of the mud pump area may be had. The automatic bypass can also be used to advantage in filling up the casing when coming out of the hole with the drill stem. A pipe connected from the standpipe to the bell nipple on top of the blowout preventer is equipped with a valve operated from the derrick floor. If the pumps are speeded up slightly above idling speed, the bypass valve will not handle the volume of mud being pumped, and the excess fluid is pumped into the standpipe and then into the hole.

Principle elements in the automatic control system embodying the standpipe bypass and the remote throttle control are (1) four-inch steam throttle valves, indicated as (F) in the schematic diagram; (2) main air control valve, indicated as (A); (3) double-acting, piston-actuated bypass valve (C); (4) four-way diaphragm-operated, spring-return valve (B); and (5) pump idling speed control valve (pressure regulator) (E).

Function of the pneumatic control system may be followed in detail by referring to the schematic diagram. During normal drilling operations, the mud bypass valve is closed. It is held in the closed position not only by air pressure but also by the mud pump pressure indicated in the standpipe. This feature prevents opening the bypass valve when there is excessive pressure in the



Schematic diagram of pneumatic controls for the mud system.

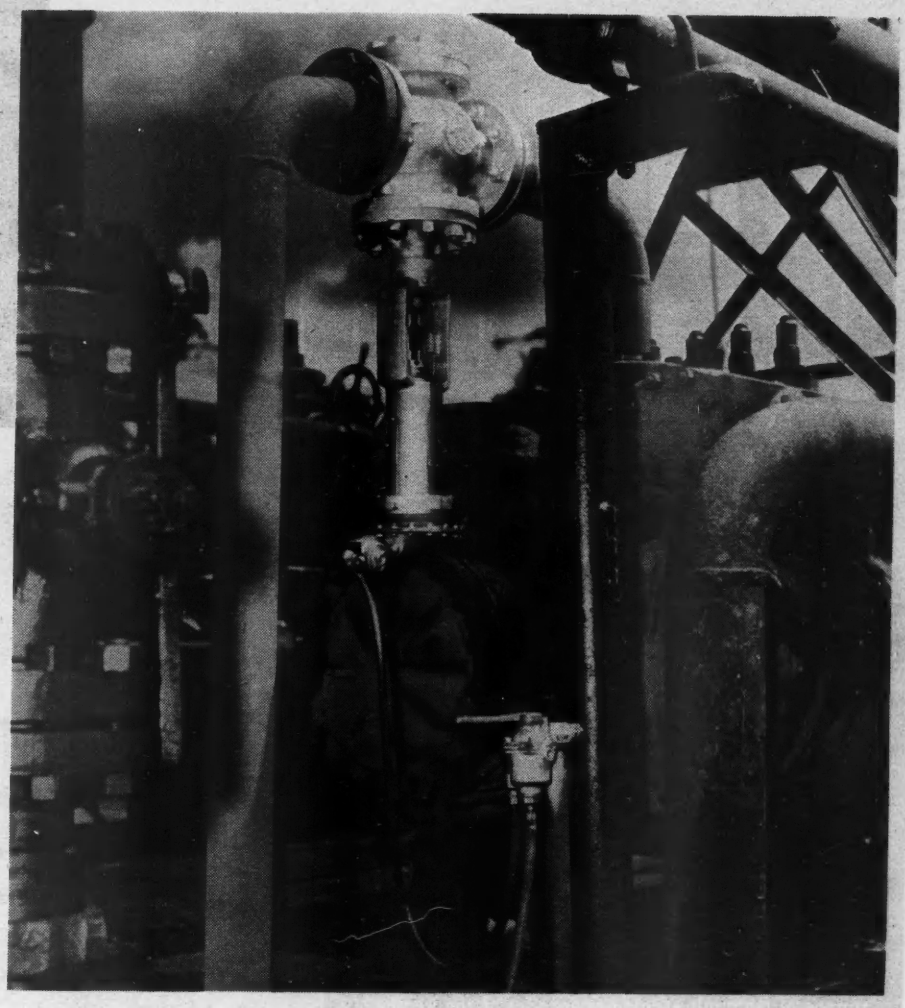
standpipe. To apply air pressure in a direction to close the bypass valve piston, the control handle on the main air control valve (A) is slowly pressed downward to the "air delivery" position. Air passes through the main air control valve and is applied to the top of the diaphragm of the four-way valve (B) which directs air pressure from the air supply to the closing line, thereby shutting the bypass valve (C). Air pressure is simultaneously applied to a double-check valve (D), which, due to the pressure differential across it, opens the line of flow so that air passes through two needle valves, two manual control valves, and to the diaphragm of the four-inch steam throttle valves. Of course, if only one pump were in use, the needle valve and manual air control valve to one pump would be closed.

If both pumps are in use and are operated in parallel, the needle valves and both manual regulating valves would be wide open. However, if the pumps are compounded, the speed relation between the two may be easily adjusted by the manual regulating valves at the pumps. These valves are of the pressure regulating type and provide very close control. By means of the manual regulating valves, it is possible to stop either pump instantly at the pump in case a gasket was blown on the fluid end of the pump and it began to accelerate. The manual regulating valve is also important to positively shut off a pump when it is being overhauled by the crew. The pump undergoing repairs cannot be accidentally started by other members of the crew working on the derrick floor.

Instead of exhausting all the air contained in the system by means of the main air control valve, two quick releasing valves in the line provide fast discharge of the compressed air, thereby reducing the time lag from full pressure to full exhaust. These valves open immediately when the upstream pressure is reduced slightly and remain open until the downstream pressure is dissipated to a point where it equals the upstream pressure. When the upstream pressure is increased, the exhaust ports automatically close.

Automatic Bypass

When it is necessary to add a joint of pipe to the drill string, break off the kelly to retrieve a core barrel, or stop for other operations requiring relatively short down time, the flow of mud into the standpipe can be diverted back into the slush pit while simultaneously slowing down the mud pumps (or pump) merely by raising the main air control valve handle to the "air exhaust" position as shown in the schematic diagram. High pressure air in the system is immediately exhausted by the quick release valves (I) and the main air control valve (A). Pressure on the diaphragm of valve (B) is released, thereby returning the valve to normal position. During the instant the air pressure is exhausted from the diaphragm of the four-inch steam throttle valve, the valve momentarily shuts to stop the pumps or to cause them to hesitate.



Four-inch throttle valve mounted in mud pump steam line. Both pumps are similarly equipped. Each throttle valve is inverted for convenience. Manual control valve is mounted on pipe upright in lower foreground.

Compressed air is then fed from the main air supply through the four-way valve (B) into the bypass valve open line to cause the valve (C) to open and allow the flow of mud to return to the slush pit. If, for any reason, there should exist a high pressure in the standpipe, the bypass valve will not open. Air pressure is simultaneously applied to the pump idling speed control valve (E) by which the pressure is reduced from 100 psi to approximately 20 psi or whatever pressure is required to maintain the pumps at idling speed. This reduced pressure is sufficient to open the double-check valve (D) inasmuch as there is no pressure exerted on the opposite side of the check plug. Air pressure is released at about 20 psi onto the diaphragm of the spring-loaded throttle valves. This amount of pressure is sufficient to open the valve slightly so the pumps will idle. The amount of reduced air pressure imposed upon the throttle valve diaphragm can be adjusted easily at the control pedestal by the idling speed control valve (E). Pressure here can be varied from zero to full line pressure by rotating the adjusting wheel.

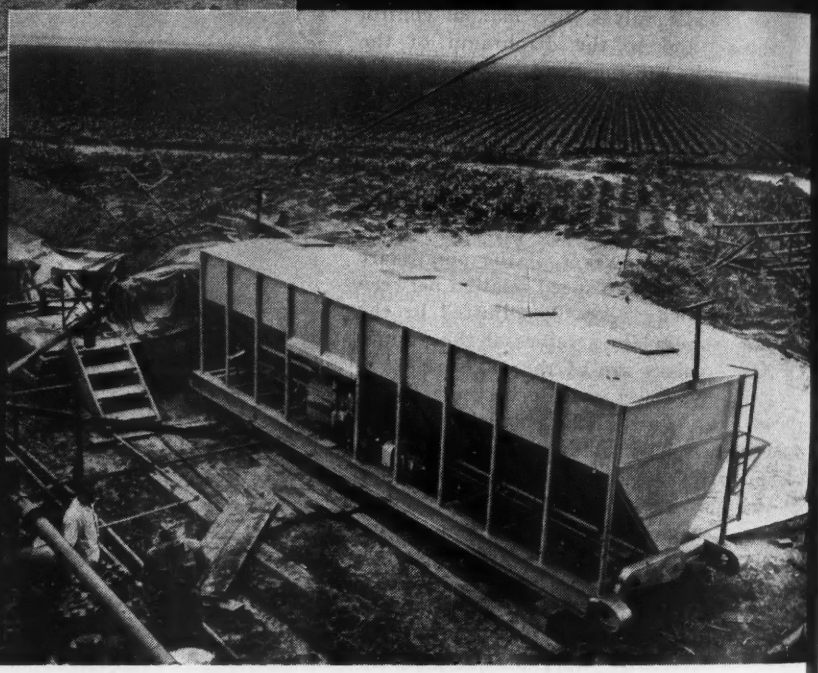
Other Applications

While the description given above applies to steam-powered pumps, the use of air to reduce time in shutting down pumps, to control pump speed, and to bypass the flow of mud can be applied equally as well to mud pumps powered by electric motors or by internal combustion engines. Primary difference in arrangement would be in the method of applying air to control a rheostat for electric motors or throttles in the case of internal combustion engines. These air controls are ideally suited for drilling barges, where, because of space-saving reasons, the mud pumps are normally located below decks out of sight, and controlled by valve extensions terminating at the derrick floor. Observation of the air gauges and mud pump pressure gauge will give positive indication of what is happening to the pumps below.

Bulk Handling Conserves Mud Materials

BY ELTON STERRETT
Engineering Editor

The hopper plant contains enough 1000 sacks of bentonite or other mud additive and some 300 sacks of gel material. Storage is dry and quantity on hand may easily be determined by visual inspection through the filling hatches. Objects on the walk are slitters designed to permit storage of material delivered to the rig in sacks.



Power side of the hopper, showing chain drive from shaft to feed screw at the end of the unit as well as general lineup of the hopper for delivering mud materials. In contrast is the hand hopper at the extreme left with sack storage of materials exposed to vagaries of the weather.

ELIMINATION of the bag or other unit container for mud materials, bentonite and gels, through the substitution of bulk handling equipment is being successfully worked out in the deep Saxet field and other areas where the drilling program calls for depths below the 10,000-foot mark.

Hoppers which replace the conventional mud storage house, and which provide dry, non-sweating, weatherproof steel bins are now being used. They can accommodate up to 1000 sacks of mud additives, in addition to some 300 sacks of gel material. The two bins for these materials are built end-to-end on a standard skid, with access hatches for filling from bulk trucks. A screw-type conveyor tunnel forms the base section of the hoppers, both screws feeding into a common mixing chamber directly above the valve to the mud jetting line. Since the screws operate in a formed channel and are of a known diameter, they feed a definite, known amount of either bentonite or gel material for each turn of the screw shaft. Flow to the screws is by gravity, insuring a full tunnel until the material is exhausted.

To provide proportioning of the materials from the two bins, the feed screws, which are of the same size and thus deliver equal quantities of material per revolution, must be driven at different rates. From a four-speed and reverse transmission immediately behind the engine, the drive then enters speed-change boxes on the two shafts which give a wide range of deliveries when the engine is throttled to a standard speed. At idling speed, for instance, feed of the gel may be varied from a minimum of 1⅜ pounds per minute to a maximum of 9.6 pounds per minute over a wide range of increments. At the same time feed of the mud additive will range from 64.5 pounds of material to 564 pounds per minute. By increasing the speed of the power unit, both minima and maxima may be stepped up to meet augmented demand.

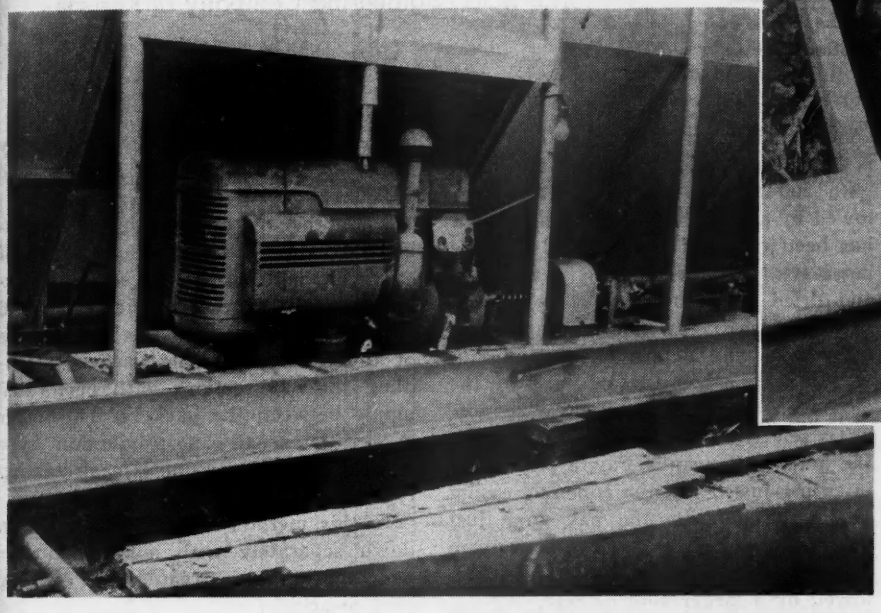
Bulk handling of cement, boon to cementers and drilling crews alike, has been adapted to the handling of bentonite, gel, and other mud additives, so that only the set of a lever and the speed of the driving unit determine the flow of materials to the pits. This article describes a unit successfully meeting mud demands at a South Texas rig.

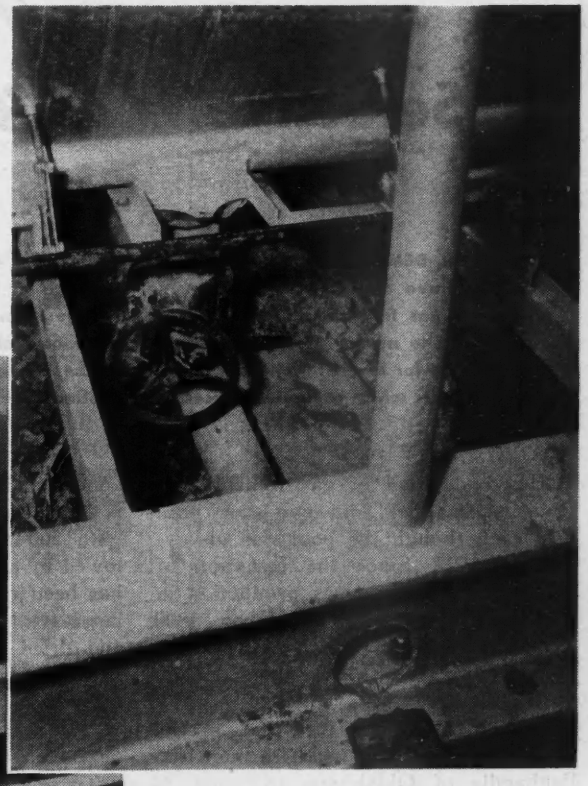
Due to the separate transmissions affording speed changes to the two bins, either material may be fed alone or both in combination, with no adjustment to the flow unit directly above the mud line.

Both feed screws discharge into the mixing chamber directly above the mud line, the two advancing columns of material being mixed by the drive as they meet and drop through the opening into the jetting system. A spring loaded inspection door at the back side —as distinguished from the power side —of the unit permits visual checking of the flow of material. The door also acts as safety valve to prevent overloading

BELOW: The power unit which drives the twin feed screws through separate, variable speed transmissions providing wide range of proportions of additives and gel. All control levers and pedals are set within the overhang of the bin to eliminate damage while on the move.

RIGHT: Closeup of the slide closing off the mixing chamber feed and the gate valve mounted on the mud jetting line. The narrow gap between hopper and upper edge of the valve body is to provide visual check of feed and also to permit flow of material without building up back pressure in case of line stoppage.





of the screws in case the flow to the mud line becomes cut off. Pressure of material against the inside of the door forces it open, allowing the accumulated material to flow out onto the ground.

Unloaders at the outer ends of both feed screw tunnels are fitted so that, if there remains a sizable amount of stock in the bins at the end of a well job, the material can be fed out into a hopper and thence redeposited in a bulk truck for transfer to another site. The unloaders are equipped with relieving devices to avoid possible damage to screw or hopper in case the drive is reversed and material fed against the bulkhead.

The hoppers are built to comply with required highway clearances when mounted on an oil field trucking unit, and the skid which supports the assembly is sufficiently rugged and adequately braced to permit skidding across country to an adjacent location, if required.

Each of the four mud material hoppers is equipped with a sliding gate at its base, so that material may be held back from the feed screw if desired. Controls of these gates are placed on the side of the unit away from the power drives, to avoid the necessity of coming into close quarters with the drive shafts for any purposes other than occasional lubrication during the time the unit is in place at the rig. Other controls, for engine, main clutch, and both transmission drives, are built within the overhang of the sloping bin and are thus protected against possible damage while on the move. The main clutch is operated by a pedal set to swing within the webs of the H-beam which forms the skid, with the engaged position of the pedal close up under the upper web.

Control of the material to the jet is through a slide set into the bottom of the hopper at the mixing point, and thence into a gate valve set atop the mud line. The jet line passes under the skid, through two ells, and thence to the open throat of the feed device. A half-inch gap is left between the base of the hopper feed and the top of the gate valve, to allow visual check of the flow, and also to provide relief in case mud flowing through the jetting system is cut off for any reason. In this case material will pile up and flow through the narrow slot, giving indication of trouble without imposing excessive pressures on any portion of the feed mechanism.

Where bulk handling equipment is not available for transfer of materials from supplier storage or railroad hopper cars, sacked material must be used. To meet this case, removable slitters are provided which set into the roof hatches of the bins, permitting quick emptying of the containers and allowing quantities to be stored during dry days against possible delays in bad weather.

In addition to weatherproof storage of ample stocks of materials, the bins provide accurately metered flow of materials in any desired proportion to the mud pits, and the slugging or lumping characteristic of hand feed is avoided. Personnel benefits through elimination of the need to work in the dusty atmosphere around the hopper, and the rig gains through increase of manpower made available by the automatic features of the hopper, which render close attention unnecessary. Once the mud engineer's requirements are made known in total pounds or pounds of material to be fed per minute, only the time of start and stop must be observed after the engine has been regulated to the desired base speed. Tachometers and revolutions per minute counters provide the basic data from which mud additives may be directly computed once time and speed ratios are known.

Successful adaptation of hopper feed to mud materials is another forward step in the development program which eliminates hand and back work on the part of the crew in favor of metered, power operation. And, with the provision of transfer equipment suited to handling materials in bulk, the cost of around 20 cents per sack for the container will be eliminated or replaced by a charge of not more than one third that amount for quantity handling.

Selective *Acidizing* at Hugoton

WITH THE DEMAND for natural gas on the increase operators have undertaken an intensive campaign in the Hugoton gas field considered the world's largest single reserve. The nature of the producing formations makes them ideal for acidizing and the article describes some of the methods which are being successfully applied.

By E. S. (JACK) VILLINES,
The Acid Engineering Company of Kansas

THE acidization of gas wells in the Hugoton gas field did not start until 1936 even though the pool was discovered in 1927. Since the inception of acidizing to increase gas production in the pool, there have been over 1800 wells completed in the vast pool with only about half of the proven acreage drilled to date.

The Hugoton field ranges from the Panhandle of Texas, north through the Panhandle of Oklahoma, to some 20 miles north of Lakin, Kansas, an area of over 200 miles in length and 50 miles in width. It is the largest known gas reserve in the world.

The gas from the Hugoton pool is produced from the Sumner and Chase groups of the big Blue Limestone series which comprise a part of the Permain Age system. This pay section is locally known as the Fort Riley, Towanda, Winfield, Krider, Herrington, and Hollenberg. The lower zones, the Fort Riley and Towanda, are limestone; the Winfield, Krider, Herrington, and Hollenberg zones are dolomitic in nature. These formations are some 250 feet thick and range from 2700 feet in depth on the north end of the pool to 2875 feet in depth on the south end of the pool.

Selective Acidizing

The demand for natural gas during and after the war furnished an incentive for more new and improved types of well completions to speed up drilling programs and obtain better results from acid treatments.

There are almost as many completion methods being used in the Hugoton gas pool as there are operators and each of these methods has its advantages and disadvantages, depending upon operating conditions in the field and completion practices already set up by the operator. Many companies selectively acidize each zone separately and in the following methods.

1. One method of selective acidizing is done by setting long string of casing on top of the bottom, or Fort Riley zone, leaving that zone open. This zone is given a breakdown acid treatment with 500 to 2000 gallons of acid, followed by a larger acid treatment after it has been swabbed in and dried up. The large treatment is likewise swabbed in and dried up before next zone is prepared for treatment. The amount of acid used is usually determined by amount of pay section being treated and by the characteristics of that particular section.

To selectively treat the next zone up the hole, or Towanda Pay, a plug is set in casing just below the zone and casing perforated opposite the pay zone just above the plug. This zone is then given the usual breakdown acid treatment followed by a larger shot of acid.

This procedure is repeated in the remaining Winfield, Krider, and Herrington Zones, the two latter zones usually being perforated and acidized together. The Hollenberg is eliminated in some areas and is usually treated separately.

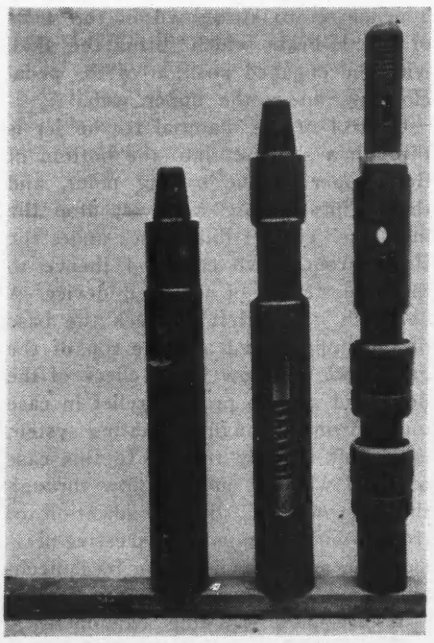


FIGURE 1 (Left to right). Letting-in tool for running packer in well; combination socket for removing packer from well; selective acidizing packer.

Some operators then give the entire pay section a large wash shot with around 20,000 gallons of acid.

2. Another method of selective acidizing is done by setting the long string of casing through all the pay sections, perforating all zones at one time and acidizing each zone separately by means of tubing and multiple packers straddling the pay sections with perforated nipple between the packers. The lower packer is usually a production type packer, while upper one is a circulating type.

In this method the zones are broken down separately with acid treatments and then all zones treated with one big shot of acid.

3. Another method employed is using the selective acidizing packer in selectively acidizing each zone separately. The long string of casing is set on top of bottom zone and that zone treated in open hole and swabbed in before next zone is prepared for treatment.

In treating the next or Towanda Zone, the casing is perforated opposite the zone to be treated and the selective acidizing packer is run into hole with "letting-in" tool on cable tool drilling line as shown in Figure 2 and set just below the perforations with an anchor extending on to bottom of hole. The drilling line and tools are disengaged from selective acidizing packer and withdrawn from hole, leaving the selective acidizing packer set in hole at desired position.

This perforated zone above packer is then given the breakdown and large shots of acid and is swabbed in before the selective acidizing packer is removed by means of combination socket on cable tool drilling line as shown in Figure 3. Running selective acidizing packer in and removing from hole requires about 20 minutes for each trip.

This selective acidizing packer is unique in its simplicity since it has no working parts, thus eliminating the possibility of trouble. It is similar to a swab with packer rubbers, as shown in

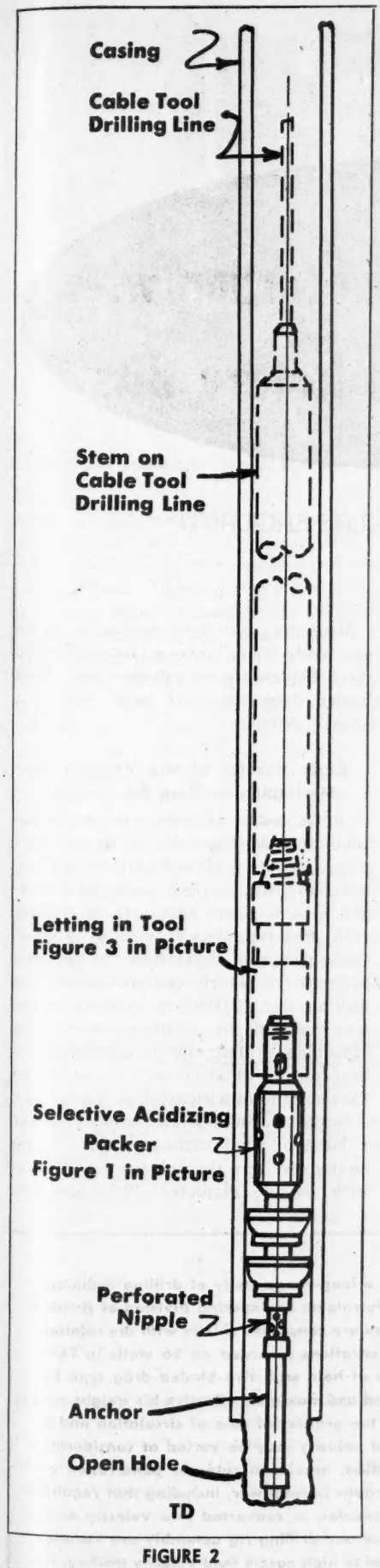


FIGURE 2

Figure 1. The cup rubbers of the selective acidizing packer are forced against the walls of the casing for a shutoff by weight of fluid above, setting up tighter against casing as pressure is applied during treatment.

When fluid above packer is being swabbed off after treatment, the gas from lower zone or zones tends to assist in cleaning up zone just treated above packer, since the packer is provided with a check valve arranged so gas can pass up through packer body as well as around the packer rubber cups.

The remaining zones are then individually perforated and selectively treated the same way. This method effects a saving of both time and expense over any of the other selective acidizing procedures. In selectively acidizing a well making over 10 million cubic feet of gas, a special check valve is used in anchor below packer so packer can be removed from hole while hole is still loaded with water.

Partial Selective Acidizing Method

4. A partial selective acidizing method is used by setting the long string of casing in top of top zone and drilling two top zones, Krider and Herrington first, since these two dolomitic zones are considered tighter than the lower zones.

These two zones are broken down with a 3000-gallon treatment of acid and the hole is deepened through other zones to total depth. With these tighter zones broken down it is assumed that the acid will be more evenly distributed throughout the entire pay section. The entire pay section is then treated with a large shot of acid after a liner is run in open hole. A wash or cleanup shot is then usually given the entire pay section.

One of the greatest handicaps to selective acidizing in the Hugoton area is communication from one zone to another during treatment, even though the long strings of casing are cemented. This menace is eliminated by one operator by perforating the casing between the pay zones and squeezing the shale sections with cement before proceeding with the selective acid treatments using tubing and packers. Even though this is probably the most expensive completion practice, it has proven to be the most effective from standpoint of good results and higher deliverability.

The gas wells in the Hugoton Pool are acidized with varying amounts of acid, ranging from 15,000 to 60,000 gallons per well, the average being around 20,000 per well. The amounts of acid used are usually determined by the thickness of pay section and its geological characteristics as obtained from electric logs or sample analysis.

Regardless of the method employed in selective acidizing in the Hugoton field, the large shots of acid should be pumped into the formations with a sufficient injection rate to maintain some pressure throughout the treatment, if possible. Since the acid will tend to go to the trend of least resistance, sufficient pumps should be used to maintain an injection rate that will cause the acid to penetrate new permeability and porosity throughout the entire formations or pay sections being treated.

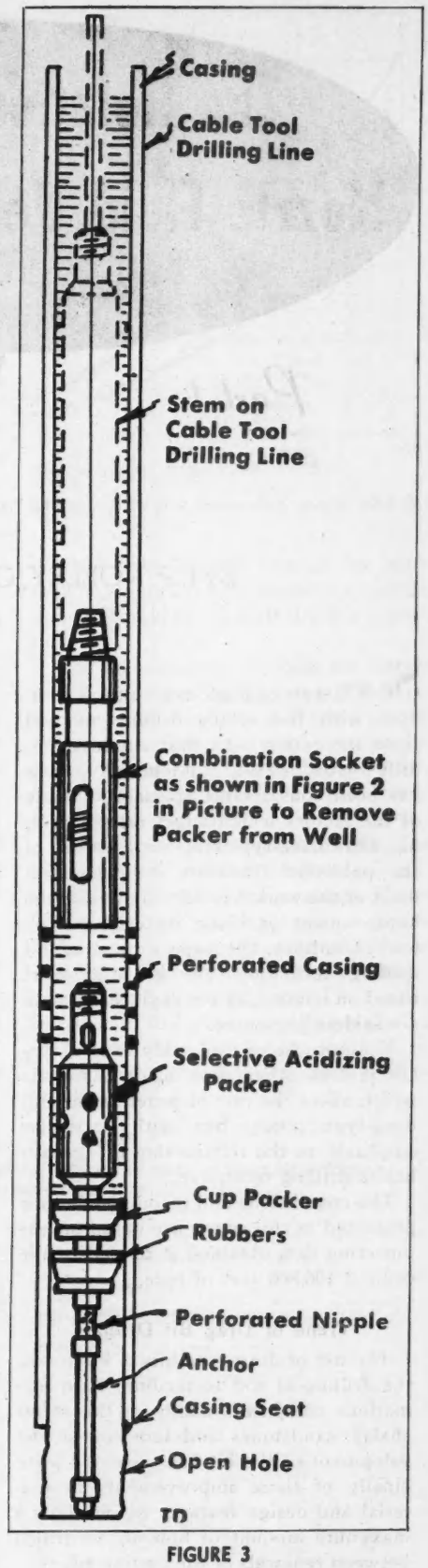


FIGURE 3

Fluid Velocity Is

Part 1

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SOME style of blade-type bit has been used with the rotary drilling method since the rotary was first employed to drill for oil in 1895.[1] Undoubtedly, there has been considerable specialized study of the factors which affect rate of drilling with blade-type bits, but a survey of the published literature indicates that most of the work has been limited to the improvement of blade materials. With few exceptions, the papers on drag bit drilling technique[2] are in large part based on opinion, as the engineering data are seldom presented.

The purpose of this study is to evaluate factors other than blade materials which affect the rate of penetration with drag-type rotary bits with particular emphasis on the relationship of hydraulics to drilling technique.

The conclusions and recommendations presented in this paper are based on engineering data obtained at 26 wells while drilling 106,800 feet of hole.

Trend of Drag Bit Drilling

The use of drag-type bits is limited to the drilling of soft to medium hard formations composed mainly of the softer shales, sandstones and limestones. Development of the bit has consisted principally of those improvements in material and design features which allow a maximum amount of hole to be drilled between renewals of the cutting edges.

Drag bits used in early day rotary drilling were usually hand forged and crudely heat-treated at the drilling site. Present day commercial types of drag bits, as illustrated by Figure 1, are equipped with heat-treated, drop-forged steel blades. Tungsten carbide inserts applied to the face of the blades and to the reaming edges account for a tremendous increase in footage per bit in comparison with the early designs. Other improvements, such as replaceable blades which prolong bit body life, have also been developed.

Drilling fluid nozzles in most current bit designs are replaceable steel alloy tubes, usually one per blade, welded into the bit body. Although some drillers have maintained a preference for nozzles of small bore, the materials used for nozzle tubes have not been adequate to withstand the abrasive action of drilling fluids at high velocities. Consequently, the trend has been to employ nozzles of a bore sufficiently large that destructive fluid velocities are not attained even with the larger circulating pumps. Current practice embodies the use of nozzles ranging from seven-eighths to 1¼-inch bore with resultant nozzle fluid velocities of from 50 to 200 feet per second and with apparently little thought being given to the possible effect of nozzle fluid velocity on rate of drilling.

Most drag bits are constructed in the two-blade style; however, drag bits with three blades are in common use. Four bladed drag bits have been used to a limited extent.

Early Studies of the Relation of Hydraulics to Drag Bit Drilling

In the course of drilling technique development work conducted during 1943 and 1944 with a Humble Oil & Refining Company drilling rig in southern Louisiana, it was noted that rate of drilling with drag-type bits is roughly proportional to rate of circulation. On the basis of this work, which was conducted while drilling two 10,000-foot wells, a survey was made of the circulating system on Humble's drilling rigs to determine the best means of circulating a maximum volume of mud with available equipment. A logical means for circulating a greater volume of mud without adding to rig equipment was the substitution of five-inch outside diameter, 19.5-pound-per-

THIS PAPER presents a progress report on a long-range study of drilling technique, carried out as a research project by the Petroleum Engineering Division of Humble Oil & Refining Company. The data presented are concerned chiefly with the relationship of hydraulics to rotary drilling. Observations recorded on 26 wells in Texas and Louisiana while drilling 106,800 feet of hole with two-bladed drag type bits show that within wide limits of rotary speed and maximum effective bit weight, rate of penetration is directly proportional to the product of rate of circulation and bit nozzle fluid velocity. Since bit nozzle fluid velocity may be varied at considerably less cost and power than rate of circulation, maximum rates of penetration are obtained when most of the available hydraulic horsepower, including that required for a reasonable flow in the drill pipe annulus, is converted into velocity at bit nozzles. Optimum size bit nozzle charts for any drilling rig assembly are included, as are design requirements for bits adapted to high nozzle fluid velocity drilling. The paper was read before the Spring Meeting, Southwestern Division of Production, API, at San Antonio.

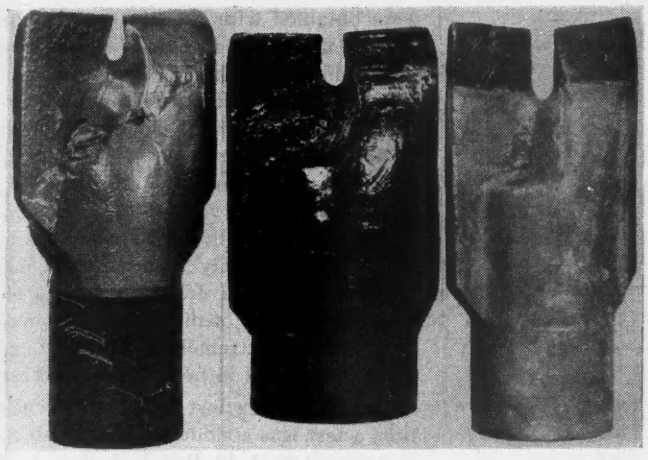

FIGURE 1. Commercial type two-bladed drag bits.

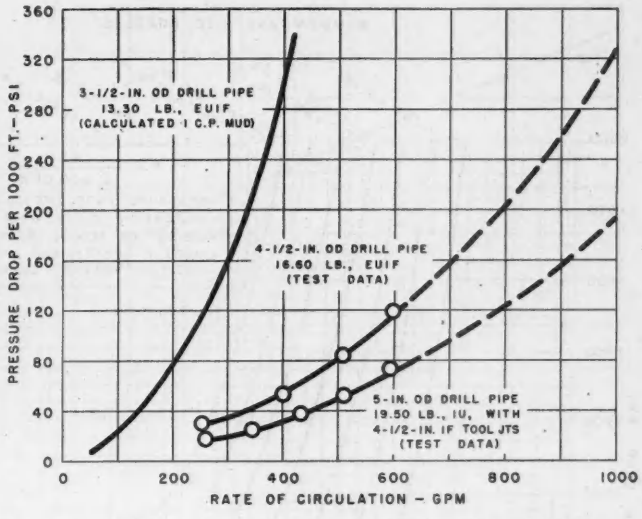

FIGURE 2. Pressure drop through drill pipe (natural shale mud—viscosity under flow conditions not determined for test data—mud weight 10.3 lb.)

foot, internal upset drill pipe equipped with 4½-inch internal flush tool joints[3] for the 4½-inch OD external upset, internal flush, 16.6-pound-per-foot drill pipe that was in common use at that time. As shown by test data in Figure 2, the pressure drop per 1000 feet of five-inch OD, internal upset drill pipe equipped with 4½-inch internal flush tool joints is approximately 40 percent less than the pressure drop through 4½-EUIF drill pipe. The five-inch OD drill pipe was field tested in several wells and satisfactory performance from the standpoint of all drilling requirements was obtained when used with the same sizes of holes (8⅝-inch and larger) that were drilled while using 4½-inch OD drill pipe. In addition to the decreased pressure drop, the five-inch drill pipe offers 33 percent greater torsional strength than 4½-inch drill pipe. Humble, therefore, decided to equip all of their drilling rigs operating in drag bit territories with five-inch OD drill pipe as the need for replacing 4½-inch drill pipe arose.

Another means of circulating a maximum volume of mud with available equipment is to enlarge bit nozzles. The pressure drop through bit nozzles was investigated, and it was found that two 1⅛-inch nozzles, as shown by theoretical data in Figure 3, required a pressure of from 50 to 200 pounds per square inch when used with circulating rates on the order of 400 to 700 gallons per minute. The calculated pressure drops have been found in close agreement with the data obtained from field tests. Since a pressure drop through the bit of 50 to 200 psi was considered of minor order in the total pressure required in the circulating system, two 1⅛-inch nozzles for each two-way drag bit were adopted as standard in Humble's drag bit drilling operations.

The pressure drop through the standpipe, hose, swivel, kelly, and drill collars, as shown by test data in Figure 4, was not considered great enough to alter the size of any of these pieces of equipment. The small magnitude of the return losses is shown by Figure 5.

In addition to the means adopted for circulating the maximum volume of drilling fluid with available equipment, Humble conducted drilling tests in seven wells during the latter part of 1944 to determine further the relationship of circulating rate to drilling rate. The results obtained in five of these wells are shown in Table 1, and the results obtained in the remaining two are illustrated in Fig-

TABLE 1

Preliminary Studies of Effect of Circulating Rate on Drilling with Commercial Drag Type Bits

SOUTH LOUISIANA AREA

LEASE AND WELL NUMBER	AVERAGE CIRCULATING RATE GALLONS PER MINUTE			AVERAGE DRILLING RATE FEET PER HOUR		
	SINGLE PUMP	COMPOUND	PERCENT INCREASE	SINGLE PUMP	COMPOUND	PERCENT INCREASE
Sarpy Brothers 1 1,400 Feet Predominantly Sand	483	596	23.4	20.6	21.7	5.3
Petit Anse Co. Inc. B-3 639 Feet Broken Sand & Shale	508	567	10.6	22.1	20.1	9.0
H. Wooster B-7 170 Feet Sand & Shale	395	437	10.6	9.1	9.0	-1.1
So. Tex. Rice Prod. 2 1,046 Feet Sandy Shale	466	634	36.0	37.7	54.7	45.0
State Land A-30 1,027 Feet Sand & Shale	454	517	13.8	24.0	21.6	-10.0

TABLE 2

Effect of Nozzle Fluid Velocity on Rate of Drag Bit Drilling at Constant Rate of Circulation

GULF COAST, TEXAS AREA

BIT NO.	NUMBER OF NOZZLES PER BIT	SIZE NOZZLES IN. I.D.	RATE OF CIRCULATION -GPM	NOZZLE FLUID VELOCITY -FT. PER SECOND	FEET DRILLED	BIT WEIGHT POUNDS	DRILLING RATE-FT./HR.
			J. F. GRANT 3				
			INTERVAL 1 - 4,312' to 5,050'				
1	2	5/8	700	365	138	8,000	151
4	2	5/8	700	365	150	8,000	204
3	2	1	700	192	150	8,000	72
2	2	1-3/8	700	75	150	8,000	82
5	2	1-3/8	700	75	150	8,000	83
			INTERVAL 2 - 6,200' to 6,600'				
9	2	5/8	630	328	100	8,000	94
7	2	1	630	129	100	8,000	53
8	2	2-1/16	630	30	100	8,000	28
9	2	5/8	630	328	50	14,000	71
7	3	1	630	129	50	10,000	88
			INTERVAL 3 - 6,607' to 7,450'				
12	2	5/8	630	328	53	6,000	66
10	2	1	630	129	68	8,000	78
11	2	1-3/8	630	68	75	8,000	36
12	2	5/8	630	328	75	8,000	84
10	2	1	630	129	75	8,000	66
11	3	1-3/8	630	68	75	8,000	51
			FRANK SCHMIDT 3				
			INTERVAL 1 - 5,000' to 5,293'				
1	2	5/8	626	327	100	10,000	102
3	4	1/2	626	256	100	10,000	80
5	2	1	626	128	27	10,000	33
4	4	3/4	626	113	38	10,000	22
2	2	1-3/8	626	67	63	10,000	20
			INTERVAL 2 - 5,366' to 5,866'				
6	2	5/8	570	296	100	4,000 to 6,000	182
8	4	1/2	570	232	100	4,000 to 10,000	122
10	2	1	570	115	100	4,000 to 6,000	87
7	4	3/4	570	102	100	4,000 to 10,000	47
8	2	1-3/8	570	61	100	2,000 to 4,000	46

TABLE 3

Effect of Nozzle Fluid Velocity and Hydraulic Horsepower on Rate of Drilling

BORREGAS FIELD - SOUTH TEXAS AREA

LEASE AND WELL NO.	BORREGAS 19	BORREGAS 42	BORREGAS 16
Depth-Feet - From	2,049	2,064	2,050
To	6,895	6,875	6,872
Hole Drilled - Feet	4,362	4,429	4,467
Rotating Hours	151.75	79.43	39.26
Drilling Rate - Ft./Hr.	28.7	55.7	114.0
Avg. Circulating Rate - GPM	550	487	700
Number of Nozzles and Diameter	2 1-1/8" ID	2 5/8" ID	2 5/8" ID
Bit Nozzle Fluid Velocity - Ft./Sec.	90	255	375
Total Hydraulic Horsepower	200	313	800
Avg. Bit Weight - Lbs.	15,000	20,000	30,000
Maximum Hole Deviation - Degrees	2-1/2	2-1/2	3-1/4

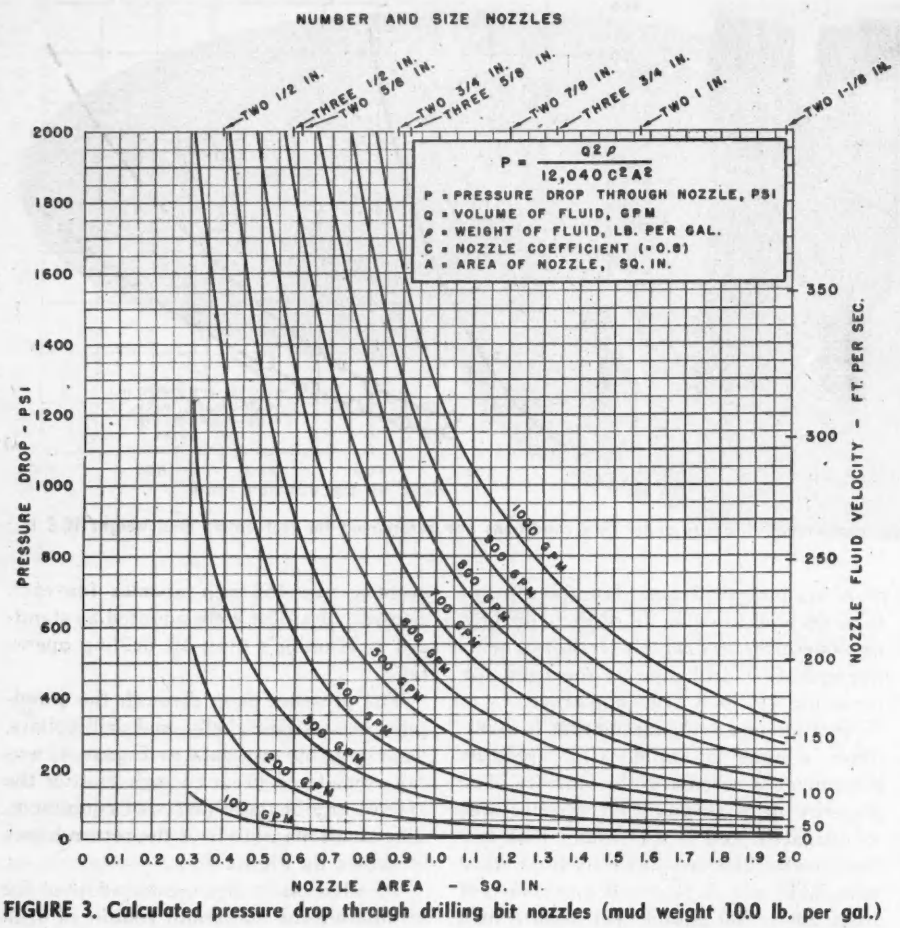

FIGURE 3. Calculated pressure drop through drilling bit nozzles (mud weight 10.0 lb. per gal.)

ure 6. The tests shown in Table 1 were conducted by alternating single and compound pump operation between joints, whereas the test results shown in Figure 6 were obtained by throttled operation of a single 20-inch duplex pump while drilling from 43 to 175 feet of hole at each rate of circulation in uniform formation. The data show that the drilling rate varied directly with the circulating rate. However, during the tests, little attention was given to nozzle fluid velocity or to bit weight, which were later to be recognized as very important factors.

The promising results indicated by the preliminary work on hydraulics led to the initiation, early in 1946, of a petroleum engineering research project to conduct an intensive study of drag bit drilling technique directed toward the evaluation of all factors which affect rate of penetration.

Circulating Rate

It was recognized that rate of circulation and bit weight were very important factors in drag bit drilling; that is, at higher rates of circulation a greater bit weight than had heretofore been considered good practice could be used without endangering the hole. In Figure 7, the results of one of the first tests conducted to determine the interrelation of bit weight, circulating rate, and nozzle fluid velocity is shown. The section to be tested was located by means of an electric survey of an offset well as a uniform section of shale. The data show that a greater bit weight can be effectively maintained on the bit at a greater circulating rate. At a circulating rate of 290 gpm, the maximum possible drilling rate was 75 feet per hour, whereas at 631 gpm, the maximum possible drilling rate was 400 feet per hour. The data also illustrate the importance of maintaining a bit weight just short of the balling-up point, if full advantage is to be obtained of an increase in the volume of mud circulated. At 20,000 pounds bit weight, penetration was great enough that complete balling up occurred at all circulating rates and nozzle fluid velocities employed.

Because the data shown in Figure 7 were obtained with the use of only one bit, the nozzle fluid velocity necessarily varied directly with the circulating rate. Hence, the exact effect of either circulating rate or nozzle fluid velocity could not be determined, inasmuch as both factors were variable during the test. However, the overall-results show that a 117 percent increase in both circulating rate and nozzle fluid velocity resulted in a 433 percent increase in drilling rate at a bit weight just short of the balling-up point. Furthermore, extremely low rates of circulation resulted in no drilling progress.

To isolate the effect of rate of circulation, a test was conducted in the Galveston Bay State A-39, Red Fish Reef field, Chambers County, Texas, to determine the effect of rate of circulation on rate of drilling at a constant nozzle fluid velocity. The test was conducted in a section of uniform shale near 8000 feet which was located by means of an electric survey of an offset well. The drillers were instructed to maintain the maximum bit weight just short of balling up, and short intervals were drilled with three bits equipped with various sized nozzles. The results of the test are shown in Figure 8, where the variation of circulating rate with constant nozzle fluid velocity and drilling rate is plotted.

The data in Figure 8 show that as the circulating rate increased from 381 to 568 gpm, or 49 percent, the drilling rate was increased from 65 to 97 feet per hour, or 49 percent. The nozzle fluid velocity during the test varied only from 116 to 138 feet per second. Such a variation is believed too small to result in any appreciable effect on the drilling rate. The drilling rate in the well referred to above was, therefore, considered to vary directly with the circulating rate.

During the early studies of the hydraulics of rotary drilling, the results of some of the tests were difficult to interpret as a result of insufficient knowledge concerning bit weight. At the start of the research project established by Humble to study the hydraulics of rotary drilling, two 6000-foot wells were drilled

TABLE 4
Effect of Nozzle Fluid Velocity and Hydraulic Horsepower on Rate of Drilling

SUGAR VALLEY FIELD - GULF COAST, TEXAS AREA

LEASE AND WELL NO.	A. B. TAYLOR 2	TRUITT & GRAVIER 2
Depth-Feet - From	3,050	3,050
To	8,030	8,168
Hole Drilled - Feet	4,980	5,118
Number of Bits Used	7	4
Rotating Hours	102.30	52.30
Drilling Rate - Ft./Hr.	48.68	97.86
Average Circulating Rate - GPM	736	479
Number and Diameter of Nozzles	2 1-1/8"	2 1/2"
Bit Nozzle Fluid Velocity - Ft./Sec.	119	391
Total Hydraulic Horsepower	403	419
Average Bit Weight - Lbs.	9,000	25,000
Maximum Hole Deviation - Degrees	3-1/4	4-1/2

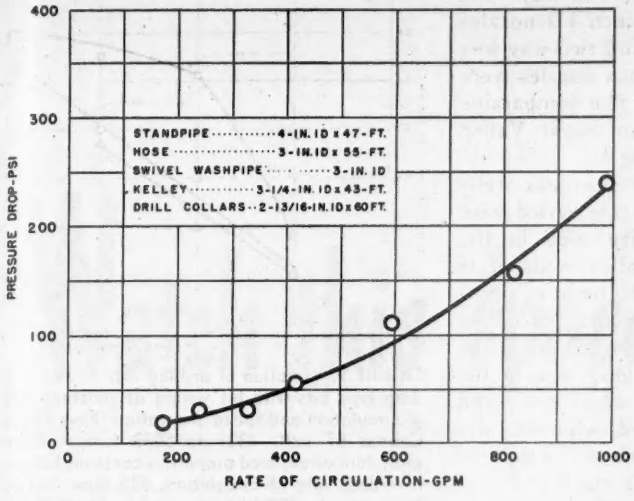
STANDPIPE ····· 4-IN. ID x 47-FT.
HOSE ····· 3-IN. ID x 55-FT.
SWIVEL WASHPIPE ····· 3-IN. ID
KELLEY ····· 3-1/4-IN. ID x 43-FT.
DRILL COLLARS · 2-13/16-IN. ID x 60 FT.
PRESSURE DROP-PSI
RATE OF CIRCULATION-GPM

FIGURE 4. Pressure drop through standpipe, hose, swivel, kelley, and drill collars (natural shale mud—viscosity under flow conditions not determined—mud weight 10.0 lb. per gal.).

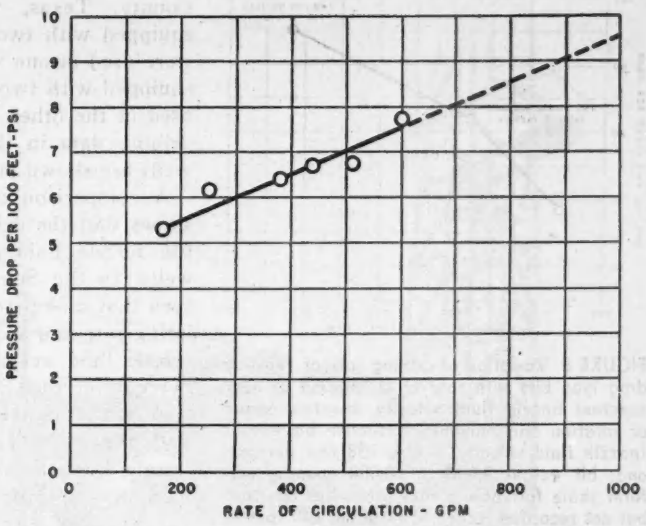

FIGURE 5. Pressure drop through annular space with five-inch O.D. 19.50 lb. drill pipe in 8.83 inch I.D. casing (tool joints, 4½-inch I.F.; mud weight 10.3 lb. per gal.; mud viscosity not determined under conditions of flow).

in the Seeligson field, Kleberg County, Texas, with the rate of circulation varying by 24 percent between wells. The drilling factors were left entirely to the drillers' judgment and, as a result, interpretation of the data was difficult because of the large variation of bit weight used by different drillers. However, as would be expected, the fastest drilling rates were usually attained by maintaining a uniformly higher bit weight.

The effect of bit weight on drilling rate was investigated further during tests conducted from 4331 to 5030 feet in the King Ranch Cabeza 67 well, Seeligson field, Kleberg County, Texas, where six-foot intervals of uniform shale in each test were drilled at various bit weights while the circulating rate and nozzle fluid velocity were maintained constant at 820 gpm and 107 feet per second, respectively. Indications during the tests were that the bit was clean at all bit weights; therefore, the factor of a balled-up bit did not enter into the tests. The results of the tests illustrated graphically in Figure 9 show that the drilling rate varies directly with bit weight. A maximum bit weight of 32,000 pounds was used during the tests because of a limited number of drill collars in use. However, had enough bit weight been applied to the bit, balling up would have occurred, and rate of drilling would have slowed or stopped. This effect is illustrated in Figure 7 where the bit weight at each rate of circulation was increased until the bit was balled up. In addition to the balling up effect shown in Figure 7, the effect of bit weight on rate of drilling is also shown.

Nozzle Fluid Velocity

To determine the effect of drag bit nozzle fluid velocity on the rate of drilling, a series of tests was conducted in the J. F. Grant 3 well in the Sugar Valley field, Matagorda County, Texas, the results of which are shown in Table 2. The trend of the results indicates that drilling rate can be increased with an increase in nozzle fluid velocity. These tests, however, were considerably affected by changes in formation between the relatively short intervals drilled.

Another series of tests was conducted in the Frank Schmidt 3 well, Danbury field, Brazoria County, Texas, the results of which are also shown in Table 2. Through Interval 1 in the Frank Schmidt 3, a constant bit weight was maintained, but through Interval 2, the maximum bit weight just short of balling up the bit was used. Through Interval 1, even though the bits were spudded at any time deemed advisable, it is believed that the bits with the larger nozzles were unduly penalized because of balling up resulting from too great a bit weight. To prevent this through Interval 2, the maximum bit weight just short of balling up was maintained. It is believed, therefore, that the results obtained through Interval 2 in the Frank Schmidt 3 well, Danbury field, Brazoria County, Texas, are more indicative of the true relation of nozzle fluid velocity to rate of drilling with drag-type bits. Data from the Frank Schmidt 3 well on drilling rate versus nozzle fluid velocity are plotted in Figure 10. The results indicate

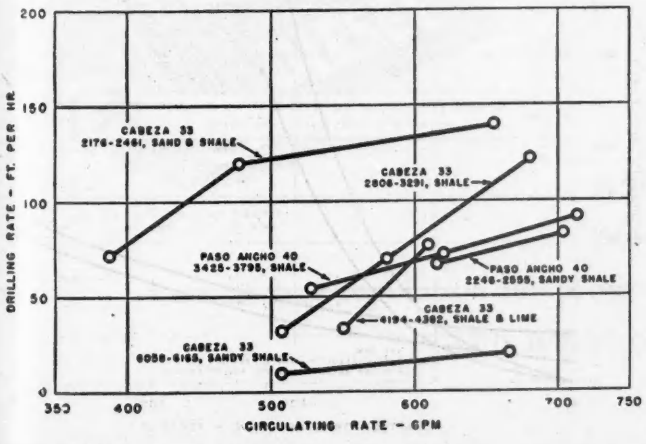

FIGURE 6. Variation of drilling rate of two-way drag type bits with rate of circulation at constant nozzle diameter (speed of rotation, 85 to 110 rpm; bit weight 6000 to 10,000 lb.; bit nozzle sizes not recorded; mud properties constant but not recorded.—South Texas Area).

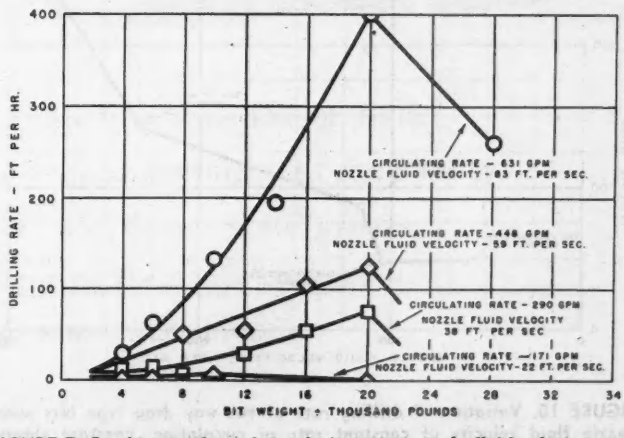
CIRCULATING RATE - 631 GPM
NOZZLE FLUID VELOCITY - 83 FT. PER SEC.
CIRCULATING RATE - 448 GPM
NOZZLE FLUID VELOCITY - 59 FT. PER SEC.
CIRCULATING RATE - 290 GPM
NOZZLE FLUID VELOCITY
38 FT. PER SEC
CIRCULATING RATE - 171 GPM
NOZZLE FLUID VELOCITY - 22 FT. PER SEC.
DRILLING RATE - FT PER HR.
BIT WEIGHT - THOUSAND POUNDS

FIGURE 7. Combined effect of circulating rate, nozzle fluid velocity, and bit weight at constant speed of rotation on rate of drilling with two-way drag bits (mud properties constant; uniform shale; King Ranch Cabeza. 68 well—3110 to 3212 feet—South Texas Area).

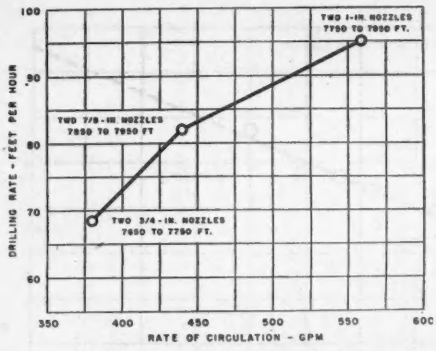
TWO 1-IN. NOZZLES
7750 TO 7950 FT.
TWO 7/8-IN. NOZZLES
7850 TO 7950 FT
TWO 3/4-IN. NOZZLES
7650 TO 7750 FT.
DRILLING RATE - FEET PER HOUR
RATE OF CIRCULATION - GPM

FIGURE 8. Variation of drilling rate of two-way drag type bits with rate of circulation at near constant nozzle fluid velocity, constant speed of rotation and maximum effective bit weight (nozzle fluid velocity, 116 to 138 feet per second; bit weight 8,000 to 10,000 pounds; uniform shale formation; mud properties constant but not recorded; speed of rotation, 140 rpm.—Gulf Coast, Texas Area).

that the rate of drilling that can be obtained with drag-type bits in the type of shale encountered in the Schmidt 3 is in direct propotion to the nozzle fluid velocity when the rate of circulation is constant and a maximum effective bit weight is maintained.

To evaluate the relation of nozzle fluid velocity to drilling rate on a per well basis, the 8⅝-inch hole in three wells in the Borregas field, Kleberg County, Southwest Texas, was drilled with two-way bits equipped with 1⅛-inch inside diameter bit nozzles for one well and ⅝-inch ID bit nozzles for two wells, while the rate of circulation was maintained approximately constant between wells. Maximum effective bit weights not exceeding 40,000 pounds were employed for all three wells and rotary speeds ranged from 100 to 175 revolutions per minute for each of the three wells. The drilling data accumulated during these tests are summarized in Table 3. Two wells were also drilled in the Sugar Valley field, Matagorda County, Texas, where two-way bits equipped with two 1⅛-inch ID nozzles were used in one well and two-way bits equipped with two ½-inch nozzles were used in the other well. The comparable drilling data in the two Sugar Valley wells are shown in Table 4.

A comparison of the Borregas wells shows that the drilling rate varied with the nozzle fluid velocity used in the wells. In the Sugar Valley wells, it is seen that a 34 percent decrease in circulating rate and a 228 percent increase in nozzle fluid velocity resulted in a 101 percent increase in drilling rate in the Truitt and Gravier 2 when compared with the A. B. Taylor 2, while the hydraulic horsepower developed in the two wells was approximately equal.

Utilization of Hydraulic Horsepower

The data obtained by Humble concerning drilling with commercial drag-type bits indicate that two hydraulic relationships exist; (1) the rate of drilling is directly proportional to the nozzle fluid velocity when the rate of circulation is constant, and (2) the rate of drilling is directly proportional to the circulating rate when the nozzle fluid velocity is constant.

In Figure 11, the variation of relative drilling rate with hydraulic horsepower at (1) variable circulating rate and constant nozzle fluid velocity and (2) variable nozzle fluid velocity and constant circulating rate are shown for 8⅝-inch, two-way bits, 4½-inch 16.60 pound EUIF drill pipe and approximately 10.0-pound-per-gallon mud at depths of 6000 and 10,000 feet. Data from Figures 2, 3, 4, and 5 were used to obtain the pressure losses through the various parts of the circulating system from which hydraulic horsepower calculations were made for Figure 11. A relative drilling rate of 100 percent was assumed to be

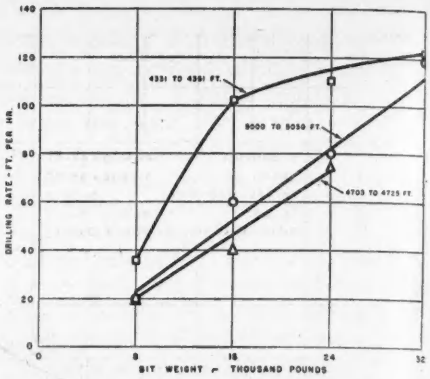

FIGURE 9. Variation of drilling rate of two-way drag type bits with bit weight at constant rate of circulation and speed of rotation (King Ranch Cabeza 67 well—4331 to 5030 feet; uniform shale formation; mud properties constant but not recorded; rate of circulation, 820 gpm; nozzle fluid velocity, 107 feet per second—South Texas Area).

the drilling rate that could be obtained at a nozzle fluid velocity of 100 feet per second and an annular return velocity of 200 feet per minute. It is seen by observation of the curves in Figure 11 that any increase in drilling rate above the 100 percent points can best be obtained by an increase in nozzle fluid velocity, rather than an increase in circulating rate for the depths illustrated. For greater depths, the horsepower advantage of increased nozzle fluid velocity over increased rate of circulation as a means of increasing drilling rate becomes rapidly larger. At shallower depths, the horsepower advantages to be gained by the nozzle fluid velocity method gradually decrease, but are never entirely eliminated. Thus, the fastest rate of drag bit drilling with any particular rig can be obtained when most of the horsepower available for mud circulation above that amount required to supply a safe annular return velocity is utilized to increase the bit nozzle fluid velocity.

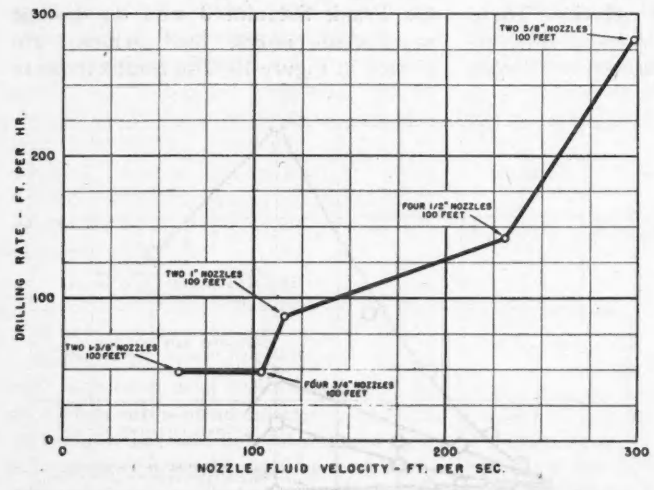

FIGURE 10. Variation of drilling rate of two-way drag type bits with nozzle fluid velocity of constant rate of circulation, constant rotary speed, and maximum effective bit weight (rate of circulation, 570 gpm; speed of rotation, 140 rpm; bit weight, 2000 to 10,000 pounds; data obtained from Frank Schmidt 3 well—5366 to 5866 feet; formation, uniform shale—Gulf Coast, Texas Area).

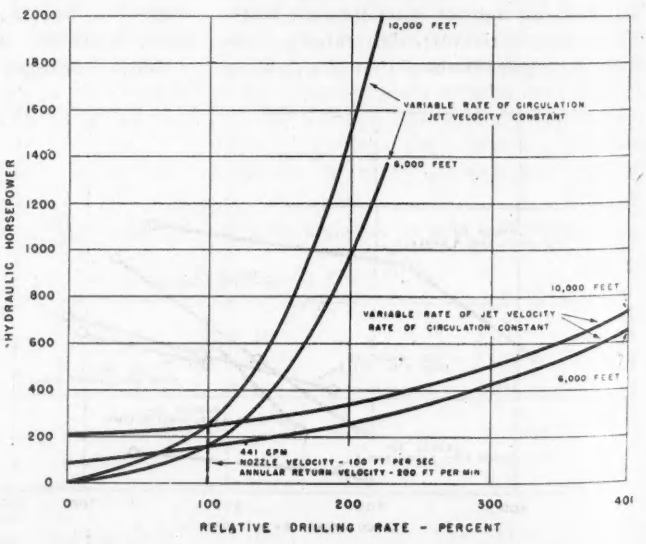

FIGURE 11. Calculated relation of hydraulic horsepower with drilling rate at constant speed of rotation and maximum effective bit weight (drill pipe, 4½-inch 16.60 lb. EUIF; mud weight 10.0 to 10.3 lb. per gal.; mud viscosity not determined under conditions of flow).

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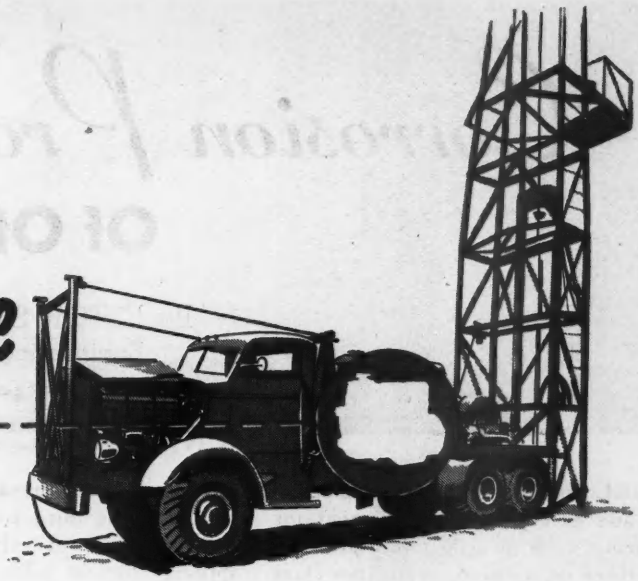

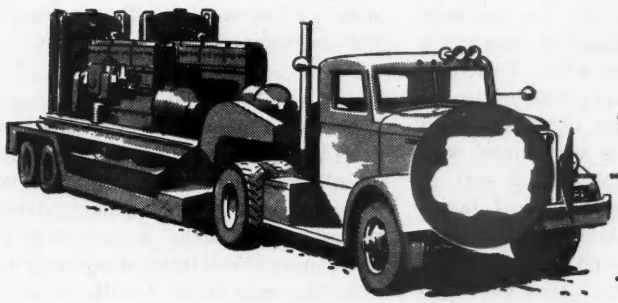

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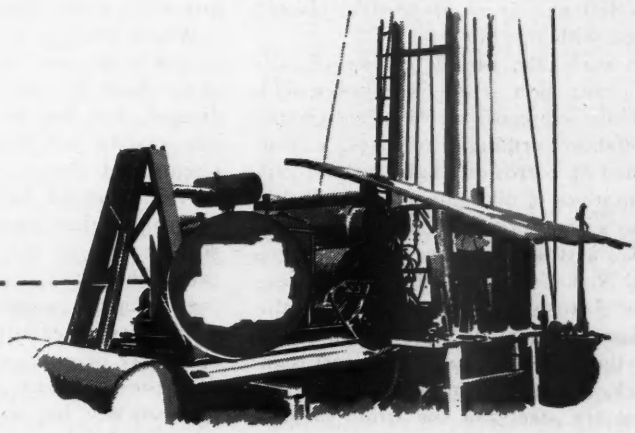

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Corrosion Problems Of Offshore Structures

By ELTON STERRETT,
Engineering Editor

STEEL used in offshore drilling structures and as completion equipment for producing wells in deep salt water presents three or, as some authorities class them, four distinct zones of corrosive activity, each of which poses its peculiar problems. There is the portion of the structure buried beneath the ooze and into the consolidated bed below the body of water; above that, a zone exposed continuously to salt water but not exposed to air; the third area, formed by a section extending from a short distance below mean low water to a point well above high water; and the fourth zone extending from the somewhat indefinite upper boundary of the third zone to the top of the structure. This latter zone is frequently classed as one with the third.

To study the various phases of salt-water corrosion of steel structures, with particular emphasis on those anticipated in offshore drilling structures, a conference of corrosion engineers and representatives of oil companies engaged in offshore operations met at Kure Beach, N. C., at the invitation of the International Nickel Company, Inc., whose sea-water corrosion installation formed the background for much of the material.

In the lowermost zone the corrosion attack, if any, lies in the reactions between the steel and the strata through which it passes, forming conditions which approach those of a pipeline laid in salt marsh, and against which like modes of protection may be advantageously applied.

Sea-Water Zone

In the second, or sea-water zone, steel may be protected against attack by several methods of insulation and also by sacrificial anodes. Where thus protected, the problems become those of maintaining the integrity of the system against the buffeting of wave action, and near the bottom, of mechanical abrasion or scour from sand carried by the swiftly moving water of the wave cycle and the slower but more continuous effect of prevailing currents.

It is in the third zone that the most serious effects of salt-water corrosion appear. On test piling exposed within the tidal range zone at Kure Beach the weight loss below the bottom of the third zone is relatively uniform and proceeds at a rate one-third or less than that of the losses sustained in zone three. Where the steel is alternately wetted by salt water and then exposed to air, or where the upper portion of the sea water contacting the steel is surcharged with air as through the action of surf or waves, the conditions are most favorable for corrosion attack and it is here that the protection must be most carefully applied and maintained if the structure is to attain maximum life.

Where steel is to be exposed for a period of one year or less, in salt waters of the Gulf, no type of protection is indicated. The loss of metal during that time would not impair the structural strength of the material and, after removal, it could be treated ashore to prevent further damage. But where a 40-year life of the structure is indicated, there are three courses open to the company engineer, with varying probability of enduring protection. The steel may be wrapped, coated or otherwise provided with a shield which will mechanically bar access of sea water, or salt-laden air, to the metal. In this class fall the various types of paints, enamels, plastic coatings, and other preservatives which must be applied on clean steel to insure bond. Any holidays permit the entrance of salt water and the formation of rust blisters which will crack and render ineffective any coating yet developed. So long as the coating remains intact, the steel should be protected.

Cladding of the steel may be regarded as another method of applying a protective coating to the steel. One method of applying either clad or corrosion-resistant alloy steel consists in joining it to the structure by welding over or through the area most subjected to attack. If this solution to the corrosion problem is adopted, care must be taken to see that all welds are annealed and completely stress-relieved, as otherwise the area of the weld can set up an area in which stress corrosion will result in extremely rapid disintegration of the metal of the weld itself or in the base area immediately adjacent to it.

Sacrificial Anodes

In experimental installations, sacrificial anodes have been found effective in affording protection to areas when the area of the anode (magnesium) to that of steel is in the proportion of 1:500 while in service tests adequate protection has been secured with even wider spread between anode and steel. Where anodes are used for protection it is found that there is a high demand on the anode until the steel becomes polarized, after which time adequate protection can be secured with much less area of anode. One solution to this high initial demand is through the use of a ribbon anode which will be consumed within a short period, perhaps some ten days, after which the standard anode will be of sufficient capacity to provide protection until it has been practically consumed.

Use of concrete to exclude sea water from steel requires a coating with a minimum thickness of from three to four inches. The concrete must be a strong mix, preferably 1:1½:3, and carefully applied over steel which is clean of both rust and grease, as otherwise the continuity of the coating may be impaired. As with other applied coatings, concrete is difficult to apply to involved shapes, and possesses the added disadvantage of adding appreciably to the weight of the structure. With rare exceptions, concrete is highly resistant to the destructive boring of marine life, and at the same time is favorable to the formation of a layer or shield of growth which not only protects the coating, but adds a buffer to preserve it against erosion and wave action.

Lost Circulation or Lost Returns

MANY THOUSANDS of dollars have been spent trying to regain lost circulation, and in many instances, such difficulties have been the direct cause of the loss of a hole or disastrous blowout. In this article, the three most common types of lost circulation are discussed. These are (1) high pressure losses; (2) low pressure losses; and (3) cavernous losses.

By E. W. LOUDEN

LOST circulation, or lost returns, of the drilling fluid in rotary drilling wells can upset a drilling program as much or more than, any other hazard encountered by the operator. In many operations the solution of this problem has depended upon hit-or-miss treatment and the application of materials chosen more from desperation than design. Many lost circulation problems respond to no simple solution. However, the application of modern materials and techniques can reduce the incidence or severity of practically all cases.

Lost circulation, or lost returns, means simply the partial or complete loss to formation voids of whatever drilling fluid is being used in the process of rotary drilling at the rig under consideration. As used in this paper, circulation refers to the mechanical process of pumping a drilling fluid down through the drill pipe, out the water courses of the bit, and back to the surface through the annular space between the drill pipe and the face of the hole. Lost returns must be distinguished from the normal loss of filtration fluid to the formation and the loss of drilling mud solids to the filter cake during the continuous filtration process which takes place on the walls of the open hole. The drilling fluid may be of any type; clay-water; clay, water, and weight material; either of the previous two with special treating agents; or oil-base. The rate or degree of loss depends upon permeability (ability to permit fluid passage) of the formation and the nature of the drilling fluid.

The many factors influencing or leading to loss of fluid to the formation make classification difficult. However, for purposes of clarity, this paper will consider three general types of lost circulation, as follows:

(1) High pressure losses
(2) Low pressure losses
(3) Cavernous losses

High pressure losses take place when high pressures are exerted against the formation. Arbitrarily, this paper defines high pressures as those exerted by muds weighing more than 12 pounds per gallon (90 pounds per cubic foot), or by those exerting a greater pressure gradient than 0.624 pounds per square inch per foot of depth. In other words, high pressure losses refer to those cases of lost circulation which occur only when the mud exceeds the densities given above. This discussion will deal primarily with mud pressures but, in order to clarify the effect of pressure on the formation, it will call attention to other methods of obtaining equivalent high pressures. All these pressures are measured in pounds per square inch, and the effect on the formation remains the same for any given pressure, regardless of the origin of the pressure.

Low pressure losses take place with the use of muds of normal weight—that is, less than 12 pounds per gallon (90 pounds per cubic foot)—into formations not actually cavernous as described below. Such losses may occur through the whole range of mud weight from 8.5 pounds per gallon (63.7 pounds per cubic foot) to 12 pounds per gallon (90 pounds per cubic foot).

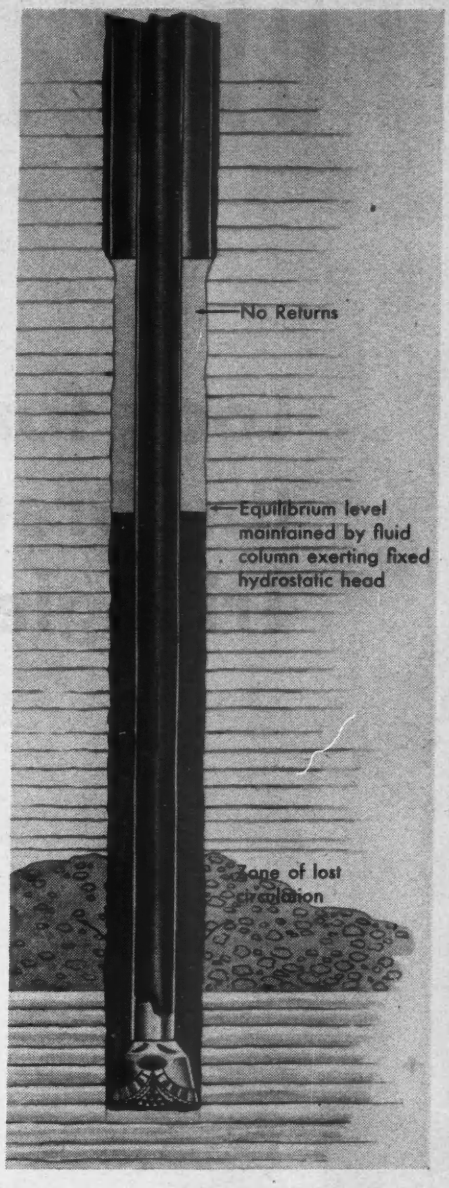
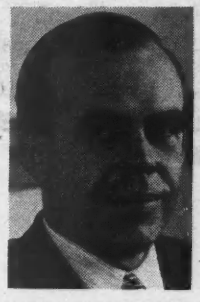


FIGURE 1. Drawing showing how permeability of porous formation may be sufficiently high to maintain fluid in annular space at a constant level.

Cavernous losses take place into actual caverns or crevices in the formation of considerable areal extent or intercon-



About the Author

E. W. LOUDEN was born in 1904 at Wilkes-Barre, Penn., and graduated from the Pennsylvania State College in 1927. He has been actively engaged in the oil business from 1934 to the present as roustabout, pumper, rotary helper, and petroleum engineer. He is field service manager for Baroid Sales Division of National Lead Company with headquarters in Houston.

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nected with other caverns or crevices. Sometimes when encountering them, the drilling tools will drop several inches or feet. Gas or water may fill the caverns. Complete and immediate loss of the drilling fluid occurs upon their penetration. Imminent danger of caving, stuck tools, and blowouts accompanies these losses.

To counteract these conditions several materials, and techniques of using them, have been developed within recent years. These include blocking materials, matting materials, and colloidal materials. Properly used, they will block the entrances to fluid-taking pores or crevices sufficiently to allow a normal filter cake to be deposited thereon, or else they will form a seal within the formation itself. Where these fail, little remains but to move to a new location and drill again, using a casing program designed to anticipate and counteract the lost circulation zones previously encountered.

The following discussion will consider each type of lost returns and suggest the means which have proved most successful in overcoming them.

High-Pressure Losses

Probably the most familiar example of high-pressure loss takes place during squeeze cementing to shut off gas or water. Here pump pressure may add as much as 5000 psi to the weight (hydrostatic head) exerted by the fluid column in the tubing or drill pipe. Thus, at 5000 feet a 15-pound-per-gallon (112-pound-per-cubic-foot) mud will exert 3900 psi against the formation. If pump pressure adds another 5000 psi, then even a comparatively small porous section, or the collapse of a small amount of bridging material in the formation, will result in a considerable loss of fluid under the combined total of 8900 psi.

The process of squeeze cementing uses a system of packers to seal effectively the annular space between casing and tubing or drill pipe, thereby preventing equalization of pressure by preventing returns. Pressure forces both the liquid and solid content of the cement slurry into the formation. Frequently this method disposes of volumes of cement far exceeding those accountable for by the formation of a filter cake of cement solids with the passage of mixing water to the formation. Coring of sidetracked holes following squeeze cementing of the original hole has showed alternate sections of formation and cement, demonstrating that the cement had been pumped bodily into a crevice formed, probably along a cleavage plane, by splitting or pressure parting the formation.

Operators sometimes employ another method, for special purposes, of applying pressures in excess of those obtained from the hydrostatic head of the fluid column alone. They accomplish this by drilling through a specially designed blowout preventer or packer and restricting the volume of returns by means of chokes. With the employment of this method, the effective pressure on the formation equals the hydrostatic head of the fluid column plus the back pressure maintained on the casing. Here again the total pressure will have the same effect on the formation as the equivalent hydrostatic pressure.

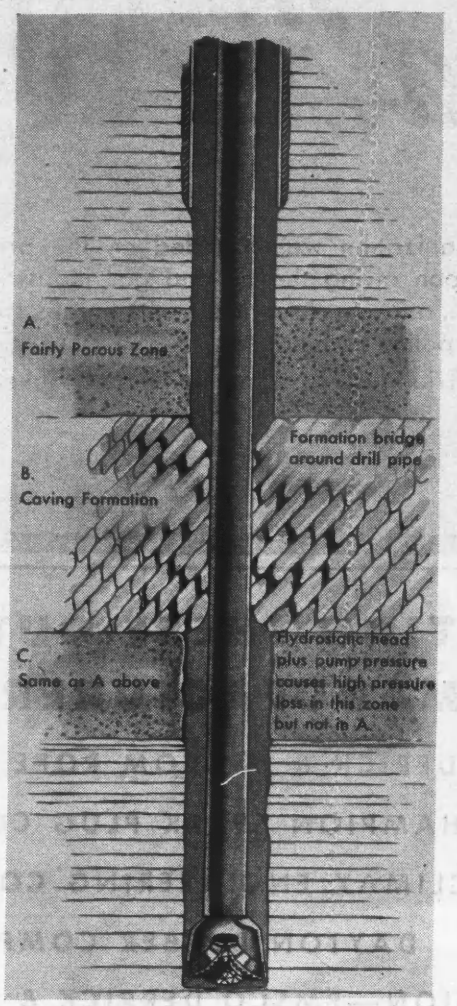
A.
Fairly Porous Zone
B.
Caving Formation
C.
Same as A above
Formation bridge around drill pipe
Hydrostatic head plus pump pressure causes high pressure loss in this zone but not in A.

FIGURE 2. Above drawing shows how increase in effective hydrostatic head caused by increased depth and pump pressure may cause loss in one zone, but not in a similar one higher up the hole.

Constant vs. Increasing Mud Weight

Operators often experience difficulty in determining the depth of the lost circulation zone if they have raised the weight of the mud as drilling progresses. A poor cement job on the casing may collapse and allow heavy mud to travel up the outside of the casing to a porous zone. Plugging and bridging agents such as cellulose flakes, mica or fiber, added to the mud will correct this condition, although comparatively large volumes of mud may be required to carry these agents to the point of loss. If the mud weight has remained constant since setting of the last casing, then the operator may reasonably assume that the loss, if one develops, occurs at or near the bottom of the hole. Corrective measures may be applied on this assumption. A third condition for lost returns, not likely to be confused with the other two, is obtained when a bridge forms between the face of the bore hole and the drill pipe, sealing the annular space and stopping the flow of mud. Thick filter cake, cavings, balled-up bit, and accumulated cuttings may cause the bridging. Whatever the cause, pump pressures increase, rotation and raising or lowering of the drill pipe become difficult or impossible. With the annular space sealed, the increased pump pressure may break down the formation and cause loss of circulation. If the pipe can be worked to a point above the bridge, circulation will be regained. With circulation reestablished, the hole can be cleaned out. At the first indication of bridging, the careful operator will examine his drilling mud and drilling procedure so that he may take corrective measures to prevent a recurrence of the trouble.

Plugging and Bridging Agents for High-Pressure Losses

The plugging and bridging agents referred to in this paper are materials—either organic or inorganic, solids or semi-solid—which are mixed in the mud to prevent circulation loss when a highly porous formation is anticipated or encountered. The mud acts as a vehicle to carry these materials to the formation and then furnishes the smaller particles to complete the plugging or bridging action. In other words, these agents provide a bridge or latticework to restrict more and more the formation channels until a regular mud seal can be deposited thereon.

Plugging agents differ from bridging agents because the latter denote a degree of rigidity which cannot be attributed to such common plugging agents as cotton seed hulls, cotton bolls, beet pulp, bran, etc. When examined in their dry form these plugging agents may exhibit a rigidity which does not remain when they have been wetted by the fluid phase (usually water) of the mud. Fragmented cellulose flake should be included in the plugging group of materials. Shredded plant fiber, primarily a plugging material, possesses fibers of such a length that they form a mat bridging one or more channel openings. This mat in turn reduces the size of the openings presented to the mud to a point at which the mud particles will bridge them suf-

ficiently for the deposition of a filter cake.

Plugging action consists of movement of the obstructing particles into the formation channels where they become lodged and restrict the passage of additional mud materials. Occasionally these plugging particles may cover the face of the channel as it is exposed in the bore hole. The effectiveness of these agents depends largely upon the degree to which they resist distortion in their pliable wet state. Records show many instances in which plugging agents, such as cottonseed hulls, cotton bolls, beet pulp, bran, etc., failed to correct lost circulation, but in which bridging or semi-bridging agents quickly sealed the formation. Decomposition of organic plugging agents may cause failure or correct the loss of circulation for only a short time. Micro-organisms readily attack the sugars and starches contained in all of the naturally occurring organic materials mentioned above. However, a special manufacturing process removes these fermentable materials from some fiber additives.

The most common commercially available bridging material consists of sized, flaked mica which may be added to the mud system through the conventional hopper. The flakes tend to orient themselves so that they lie flat against the face of the bore hole, somewhat like the shingles on a roof. The comparatively large flat surface of the flake closes or bridges the channels taking the mud. The mica is chemically inert and does not absorb water from the mud. Experience has shown that after the mica material has restored returns, the operator usually may raise the mud weight appreciably.

Use of bridging agents in the mud requires bypassing of the shale-separating screen, a practice undesirable in normal drilling. However, if the operator expects a zone to take mud, he should add the bridging agents to the mud before the bit encounters the thief zone. If he adds the agents ahead of time, they will be available for correcting the loss as soon as it occurs. If the operator adds the agents after loss takes place, circulation, of course, will take these agents to the formation taking mud, but this means that the formation will take all of the untreated mud between the pits and the troublesome zone.

Usually, loss of high weight mud occurs at a depth of several thousand feet, indicating that the hydrostatic head on the formation causes the loss. At 10,000 feet, a mud weighing 16 pounds per gallon (120 pounds per cubic foot) exerts a pressure of 8320 psi against the formation. Such pressures make the bridging agents more desirable than the plastic plugging agents. Consequently, fiber and mica materials should be added to the mud. Thus reinforced, the mud should be pumped into the hole until the restoration of returns, or until the operator becomes convinced that he must resort to some other method. However, severe cases of lost circulation have been restored even after several hundred barrels of the fiber-mica mud have been lost to the formation. No clear explanation exists for this phenomenon because in each case the bore holes have remained open even though the volume of fiber and mica entrained in the lost mud was sufficient to form a solid plug had they been deposited on the face of the formation.

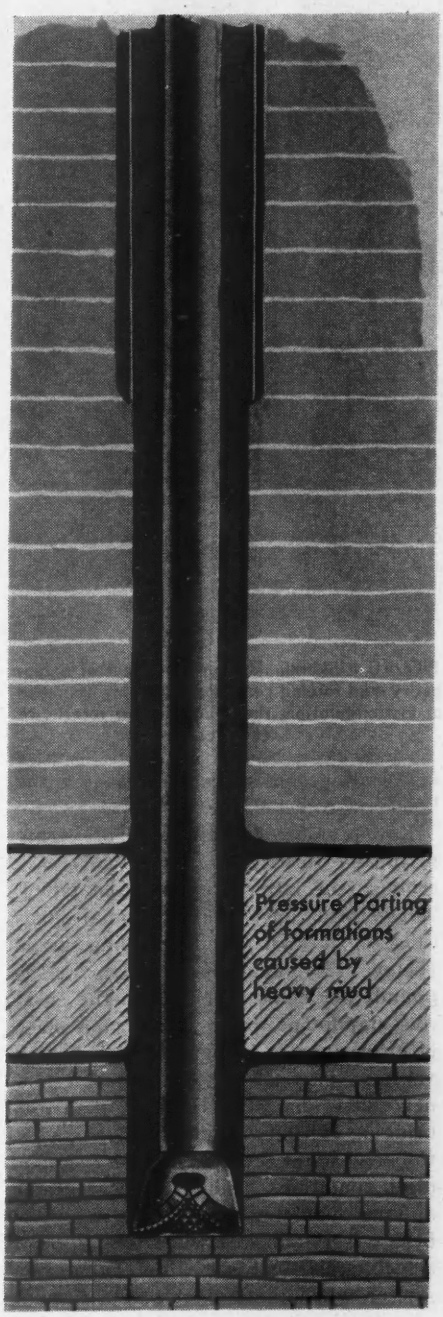

FIGURE 3. If too high weight mud is employed, formations actually may be forced apart along bedding planes, creating voids contributing to lost circulation.

Probably many of the crevices opened by high pressure do not exceed more than a few hundredths of an inch in width. The fibers and mica fill these narrow openings to increase the resistance to the flow of mud. When this resistance exceeds the hydrostatic head of the mud, returns again are established. An increase in the mud weight may open new crevices or force additional flow through the old crevice.

Reduction of Mud Pressure to Decrease High-Pressure Losses

Both lowering the mud density and reducing the pump pressure will reduce mud pressure against the formation. Sometimes operators may accomplish the difficult task of balancing formation pressure with mud pressure. Generally the range at which this balance may be maintained is quite narrow. A difference of 0.2 to 0.4 pounds per gallon (1.5 and 3.0 pounds per cubic foot) may mean the difference between lost returns and flow back of the formation fluids. This flow back, if not controlled, may easily result in a blowout. Such a procedure is not recommended unless other methods of control have failed and the expected results justify the hazards involved.

Cementing to Cure High-Pressure Losses

With the hole in suitable condition, the proper application of cement will sometimes cure high pressure loss of circulation. In order to increase its chance of success, the cement application should be similar to a squeeze job in that a portion of the slurry should be forced into the formation. A mixture of from 3 to 5 percent of gel cement at a water-cement ratio of from 6½ to 8½ gallons per sack offers many advantages for this purpose.

The use of cement in the above manner results in a plug of set cement which must be drilled out. In conventional water-clay muds, the entrained cement must be treated out with chemicals to restore desirable viscosity, gel, and filtration characteristics. Entrained cement has little or no deleterious effects on the properties of lime-organic colloid muds.

The following use of cement does not cure lost returns but deserves mention as being applicable to a complication arising from high pressure losses. Frequently, in such cases, the drill pipe becomes stuck before circulation is restored. The use of high weight muds presupposes high formation pressure. If the mud loss occurs at or near the bottom of the hole, a fishing job for the stuck pipe becomes extremely hazardous unless the loss can be corrected. The placement of a batch of cement through the drill pipe may cure the loss and facilitate fishing operations. The operator should maintain pressure on the cement

until set. If no loss or flowback occurs after setting of the cement, fishing for the drill pipe may proceed normally. It may be desirable to leave the bit and drill collars in the hole, and to sidetrack them if the hole is to be deepened. The mud used in the sidetracked hole should be treated with materials to prevent loss of mud to the troublesome section when again penetrated.

The use of chemical gels or plastics eventually may become important in treating high pressure losses.

Measures to Prevent High Pressure Losses

If preventive measures will materially reduce the loss of high weight mud to the formation, they will prove economical in the long run, though they represent considerable expense at the time of application. The unit cost of making muds increases with their weight. Loss of native mud weighing ten pounds per gallon (75 pounds per cubic foot) represents only a few cents per barrel; whereas loss of mud weighing 16 pounds per gallon (120 pounds per cubic foot) represents not less than $6 per barrel. The operator must add rig-time costs to mud costs to obtain a true picture of the total expense involved. And if the well flows out of control, the operator must add to this total the value of equipment lost, damage to the producing reservoir, and time and material required to bring the blowout under control.

Where formations to be drilled are known or thought to carry fluids under high pressure, requiring the use of high weight muds, the operator should design his casing program to fit these conditions. With modern mud control he may carry long sections of open hole, under conditions of normal pressure. But with the presence of abnormal pressures, the longest protective string of casing possible is the best. Setting of the protective casing should occur before the increase of the mud weight causes the formation to break down. If the operator knows that the formation below the surface casing "breaks down" or takes mud weighing 14.5 pounds per gallon (109 pounds per cubic foot), he should set casing before pressure control demands a mud of this weight. Assuming that he can drill to 9000 feet with a mud weighing less than 14.5 pounds per gallon, and assuming that he will require a mud of that density at 9500 feet, he should set casing somewhere between 9000 and 9500 feet.

The presence of such a string of casing will provide a protective region into which the drill pipe may be withdrawn, in case of trouble, during the application of corrective measures. If the drill pipe sticks, less pipe remains to be fished out of the open hole. The long string of casing also will prevent key seating and stuck drill pipe in the hole so protected.

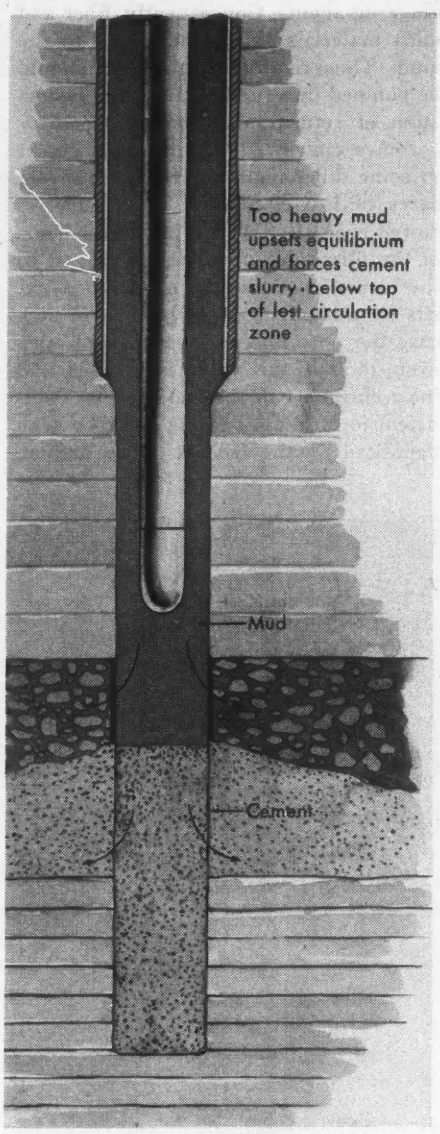

FIGURE 4. Sketch showing the effect of a too-heavy mud forcing cement slurry below the zone of lost circulation, thus allowing lost returns to continue.

Low-pressure losses occur in highly permeable formations, not actually cavernous (the latter are discussed later). These formations take substantial quantities of normal weight drilling fluids (below 12 pounds per gallon or 90 pounds per cubic foot). From the curative standpoint, these losses take place in formations of high porosity in which at least part of the individual channels have diameters greater than the bridging capacity of the mud particles. Coberly[1] states that "Tests under simple, ideal conditions, using spherical grains of one diameter, show that a stable bridge is established when the width of a rectangular slot is two times the grain size or when the diameter of a circular opening is three times the grain size. With openings exceeding these values by approximately 25 percent, no bridge will form."

While the channel openings in even a porous zone are quite small, they still exhibit the same resistance or friction to fluid flow that a pipe or tube of similar diameter would show. The channels in the formation, of course, do not exhibit the symmetry of tubes either in the opening exposed to the mud or in the constancy of diameter. Both the shape and diameter of the openings will vary widely. Neither do the bridging solids consist of spheres; but, as Coberly[2] again states "Angular grains will form a stable bridge under the same conditions as spherical grains. Due to the angularity of the grains, the point at which bridging ceases is extended to openings approximately 50 percent in excess of these values for the samples investigated."

Another factor, gelation, enters into this picture of fluid circulation losses. Gelation of the mud within the formation channels creates another type of resistance to flow, and, when properly controlled, has often been sufficient to restore circulation.

For all practical purposes, the operator may assume that these porous sections contain fluids under normal formation pressure (0.434 pounds per square inch per foot of depth) or under greater than normal pressures. The force tending to overcome the resistance to the flow of mud through these channels equals the difference between the hydrostatic pressure of the mud column and the formation pressure.

These low-pressure losses may occur in any area and at any depth. The depth at which such losses occur and the subsequent operations to be performed should influence the choice of the material or method to restore returns. A discussion of these methods and materials follows.

Mud of High Gel Strength

If loss of mud occurs at a depth of less than 5000 feet and the operator knows that he will complete the well or set casing before he encounters formation pressures requiring any considerable increase in mud weight, the use of gel-type mud presents a frequently successful and easy remedy.

The simple procedure requires only the mixing of sufficient gel-forming material with the mud in the pit to produce a thick high-gel mud. Adding from 3 to 5 percent by weight of this material to ordinary drilling mud will produce a fluid of this consistency, as will from 8 to 10 percent added to straight water. Gel strength of the resulting mud, measured on the Stormer viscosimeter after ten minutes of setting time, would approximate 200 grams.[3] This mud will secure returns after being pumped into the hole if the gel set up

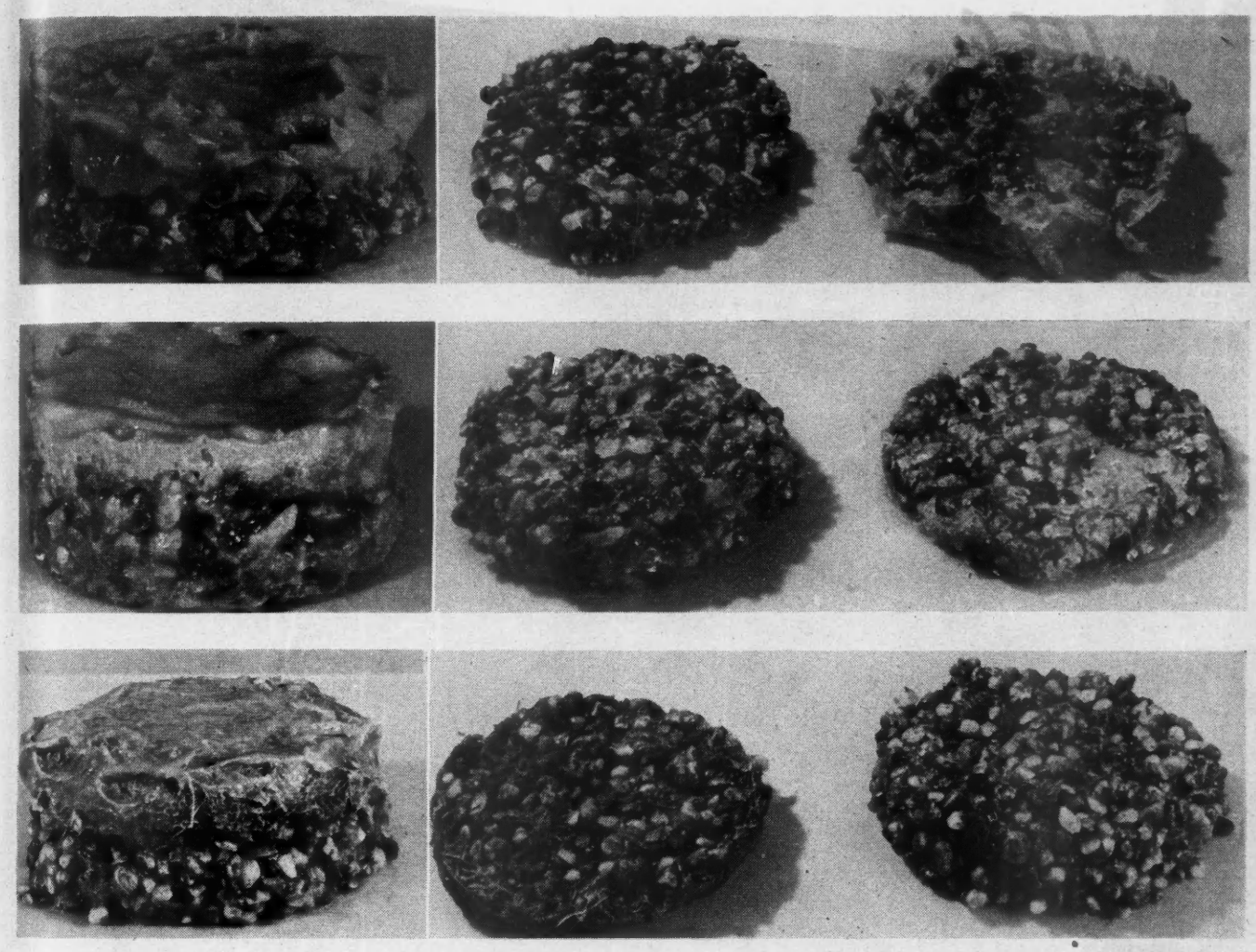

FIGURE 5. Filter cakes deposited on gravel by a mud with three different lost-circulation materials. Left picture in each case shows filter cake in place on gravel core. Right picture shows core out apart to show penetration of lost circulation materials.

in the thief channels attains a high enough value. Resistance of the gelled mud to further movement in the formation channels brings about stoppage of lost returns. Lack of information on the size and character of these channels makes calculation of this resistance impossible. Possibly in some instances this gel would resist even the pressure imposed by greater-than-normal mud weight, but where the operator anticipates the need for such additional weight, safety demands that he set casing through the porous zone, or use some other method of curing lost returns. If this method restores circulation, the operator may then cut the mud back to normal viscosity and gel strength (by adding water) and resume drilling. If raising the gel strength does not secure returns in a reasonable length of time, the operator should employ one of the methods described in the following sections.

The use of high-gel muds to restore lost circulation is recommended for all depths down to approximately 5000 feet. Below this depth such a mud may offer substantial resistance to drill pipe movement and promote swabbing until normal properties are restored to the mud with water and chemical treatment. If restoration of normal viscosity and gel characteristics requires much water, the operator may have to add some weight material to maintain a given mud weight.

Probably the most satisfactory mixture for curing low pressure losses consists of a good base mud containing both fibers and flake mica. The fibers will deposit a mat; the mica will bridge the mat and the other formation channels; the mud will deposit a thin, flexible and impermeable filter cake over all.

Use of Cement to Cure Low-Pressure Losses

This paper classifies various types of lost circulation as to cause and effect, but it does not imply thereby that a particular instance of lost circulation can be placed in one class only. Many, if not most, cases will fall partially under one type, partially under another; consequently, combinations of treatments frequently must be necessary.

If plugging or bridging agents fail to correct the low pressure loss of circulation, then the operator must resort to cementing operations. Two types surpass all others for this purpose: gel cement and quick-set cement. Common practice is to place the cement slurry in the hole through the drill pipe, withdraw the drill pipe, and allow the cement to set. The resulting plug is then drilled out and, if no additional loss occurs, drilling is resumed. If some loss still takes place, the cementing operation must be repeated. The cement treatment may seal the original zone of lost returns, but it cannot provide insurance against the loss of returns when the drill goes deeper than the cement plug. Such a repetition of lost returns, of course, calls for a repetition of the treatment above.

Of the two types of cement slurry mentioned above, gel cement because of its high angle of repose[4] serves best as a means of correcting severe losses of circulation. The gel in the cement gives to the slurry certain gel characteristics which provide its high angle of repose and causes the slurry to pile up in formation channels rather than flow away like water seeking its own level. A gel cement slurry composed of six to eight pounds of gel material and 8½ to ten gallons of water per sack of cement has been found highly successful in

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severe cases of low-pressure lost returns.

The quick-set special cements, on the other hand, exhibit the low angle of repose characteristic of all neat cements. That is, a sample of the slurry dropped on a flat surface will flow out into a thin, flat, pancake-like disc. Such a slurry will provide a plug only in the lowermost channels. In addition, the type of mixing water usually affects the setting time of these cements. This variation in setting time demands careful supervision on the part of the operator to prevent plugged drill pipe.

When cementing to cure lost returns, the operator must pay very close attention to equilibrium between the formation pressure and the hydrostatic head of the fluid in the hole. This is one of the factors least understood or taken into account in cementing operations. When returns are lost, the level of the mud in the hole will fall to a certain distance from the surface. The point at which it stops falling represents the point of equilibrium for a mud of that weight. If more of the same mud is added at the surface, the column will adjust itself to the same level, which means that the same amount of mud as added at the top will migrate from the bottom of the hole. Withdrawal of the drill pipe will lower the level of mud in the hole (4½-inch-outside diameter, 18.10-pound drill pipe displaces approximately 0.65 barrels of mud per 1000 feet), which will cause a definite amount of fluid in the formation to flow back into the hole to reestablish equilibrium. Thus, the withdrawal of a considerable amount of drill pipe after cementing may cause the cement to back up the hole above the section of lost returns, unless the operator adds sufficient mud at the surface to compensate for the loss of volume in the drill pipe withdrawn. Likewise, the addition of too great a volume of mud while withdrawing drill pipe may lower the level of cement below the level of lost returns by forcing the slurry out into the formation. If the operator cannot effect adequate equilibrium control, then he should use a comparatively large volume of cement, in which case pressure will force some cement into the formation, leaving a considerable column of cement in the hole to be drilled out after setting. The main objection to leaving any considerable column of cement in the hole is the possibility of it causing the bit to sidetrack the hole in drilling out.

Lowering the Hydrostatic Head

The use of gel-forming colloidal material, plugging and bridging agents, and cement gives positive results. If the operator knows that only low formation pressures exist, or if he plans to set casing before encountering pressure, he sometimes can establish returns by lowering the hydrostatic head imposed on the formation by the column of fluid in the hole. He can do this through either or both of two ways: first, by lowering the specific gravity (weight per unit volume) of the mud; and second, by lowering the pump pressure.

He can calculate the possibility of success of these measures as follows: First, he must locate the depth to which the mud column has fallen. This he can do with a measuring line to which a float is attached or by running drill pipe in the hole and measuring the dry part of the pipe as it is withdrawn. Next he must calculate the hydrostatic head of the mud column remaining in the hole. From this figure he calculates the maximum density required by the mud with which he plans to fill the hole. This gives an answer equivalent to a column in static equilibrium with the formation pressure but does not take into account the pump pressure exerted on the formation, or the friction to be overcome in moving the mud column; so, the actual weight of the mud should be reduced somewhat below the answer obtained by the calculation.

EXAMPLE: Assume a column of ten-pound-per-gallon mud (75-pound-per-cubic-foot), the top of which is 400 feet below the surface and the point of lost returns is at 2500 feet below the surface.

THEN: 2500 feet —400 equals 2100 of ten-pound-per-gallon mud. Since mud of this density exerts a pressure of 52 psi per 100 feet of depth, it will exert a pressure of 21x52 equals 1092 psi on the zone of lost circulation when the column is in equilibrium.

1092 psi ÷ 25.0 equals 43.7 psi per 100 feet of depth.

The 2500-foot column must not exceed this density to maintain static equilibrium with the formation.

43.7 psi per 100-foot depth equals 8.4 pounds per gallon (62.5 pounds per cubic foot).

Reduction of mud weight to 8.4 pounds per gallon (62.5 pounds per cubic foot) would not prove practical in the case cited above because water itself weighs 8.34 pounds per gallon (62.4 pounds per cubic foot). Consequently, the resulting drilling fluid would consist of little more than slightly muddy water.

But consider the following:

EXAMPLE: Assume a column of 10-pound-per-gallon (75-pound-per-cubic-foot) mud, the top of which is 100 feet below the surface and the point of lost returns is at 2500 feet below the surface.

THEN: 2500 feet —100 equals 2400 of 10-pound-per-gallon mud. Since mud of this density exerts a pressure of 52 psi per 100 feet of depth, it will exert a pressure of 24x52 equals 1248 psi on the zone of lost circulation when the column is in equilibrium.

SO, 1248 ÷ 25.00 equals 49.9 pounds per square inch per 100 feet of depth.

The 2500-foot column must not exceed this density to maintain static equilibrium with the formation.

49.9 psi per 100 feet of depth equals 9.6 pounds per gallon (72 pounds per cubic foot).

Making allowances for pump pressure and inertia the operator may assume that he must reduce the density of his mud to 9.2 or 9.4 pounds per gallon (69 to 70 pounds per cubic foot) by the addition of water (and gel forming material to maintain body). He probably will be able to restore circulation by this method under these conditions.

Lowering Pump Pressure to Restore Circulation

Reduction of the mud pump volume will reduce pump pressure. However, the minimum velocity of the mud in the annular space required to raise cuttings out of the hole limits the extent of this reduction. The operator also must remember that reduction of pump pressure as measured at the surface is not the same as the reduction obtained at the bit. Most of the surface pump pressure is used to overcome the frictional resistance offered to movement of the mud through the drill pipe. The wide variation of viscosity and gelation characteristics of different muds makes this value difficult to calculate. Actual trial on the well is still the best method of determining the effect of lowering pump pressure on lost circulation.

The use of chemical gels or plastics still is in the experimental stage. The process consists of pumping a liquid into the formation taking the mud. The liquid then sets into a solid or plastic mass which plugs the channels. Use of these materials demands a fairly accurate knowledge of the depth of lost returns and control of fluid movement in the hole (equilibrium point) during the setting period. Development probably will render this method very effective in the future.

Blind Drilling

Blind drilling may have its place in solving certain cases of low-pressure lost circulation. The term as commonly used refers to the practice of drilling ahead with water when returns are completely lost, allowing this fluid to wash the cuttings into the formation. This method naturally requires a huge volume of water. The pumps must maintain a volume output high enough to obtain a

velocity in the annular space sufficient to carry the cuttings from the bottom of the hole up into thief zone, without allowing them to fall back into the open hole. The operator should run the pumps some minutes after drilling a joint down to clean the cuttings out of the hole; otherwise, the cuttings may settle back to stick the pipe. Back flow through the drill pipe occurs frequently when connections are made, and may result in a plugged bit. A drill pipe float valve in the string of pipe above the bit will prevent this trouble.

Frequently large cuttings which the water will not wash out will accumulate in the hole. The operator should pump in a few barrels of thick gel type mud when this occurs. This thick mud will pick up and carry the cuttings out into the formation channels.

Caving sections or formations carrying oil or gas under pressure will prevent the use of blind drilling. Water pressure sufficient to produce artesian flow may be utilized to produce the water for drilling if the flow is not sufficient to interfere with rig operations. If desirable, the operator may control the artesian water flow by adding much to the annular space between surface casing and drill pipe. In using this method the operator adds mud until the fluid level in the annular space falls some feet below the surface. Further additions of mud are made when and if the fluid level in the annular space rises close to the surface.

Blind drilling does not allow any control of oil or gas movement. Oil and gas, even if confined to the hole by the water, still can migrate to the section taking the drilling fluid, a condition extremely difficult to detect. The method restricts the source of geological information to electrical surveys and cores, because, of course, neither cuttings nor mud is available for inspection. For these reasons, and because of the danger of blowouts and struck drill pipe, casing should be set as soon as the bit passes the lost circulation zone, if blind drilling has been used.

Overcoming Cavernous Losses

When the drilling fluid loss is sudden and complete, the operator may assume that the loss takes place in actual caverns or crevices of considerable areal extent, and possibly interconnected with other caverns or crevices. Sometimes when encountering them, the drilling tools will drop several inches or feet. These formation voids may be full of water or gas, or they may be dry. Operators have pumped huge volumes of mud, water, cotton batting, sacks, rope, straw, etc., into these caverns in the attempt to block or fill them. One such well took a volume of material sufficient to fill a ditch 20 feet wide, 60 feet deep, and one mile long.[5]

Such caverns will take ordinary mud indefinitely. If the fluids in the cavern are under pressure, liquid flow or a gas blowout will occur immediately after losing returns. Fluids present in exposed formations above the cavernous area may blow out also. Unconsolidated formations such as sand and gravel exposed to the open hole may cave and stick the drill pipe. If the cavernous formation is full of fluid, the level of the drilling mud in the hole will fall until it is in hydrostatic equilibrium with the pressure of the fluids in the caverns. The mud level will fall anywhere from a few feet to several hundred feet. In this type of lost circulation, the operator can do little, if severe caving takes place between the casing seat and the point at which returns are lost. The logical procedure would be to set casing below the caving section, but above the cavernous section.

Use of Low Weight Mud

If the mud stands reasonably close to the surface, and has any considerable density above that of water, the operator sometimes may obtain sufficient returns by lowering the mud weight several points. If this is done, cuttings may not be of much value for correlation purposes, since most of them will be washed into the formation. If the operator can use this method, it will permit him to drill past the porous section, whereupon he can set casing and resume normal drilling operations. The presence of fluids in the exposed formations above the caverns may make this method too dangerous to use, unless the fluid happened to be water exclusively, in which case the water flow obtained might be used as drilling fluid if such flow and use did not result in caving.

Blind drilling as described above in the section on low pressure losses sometimes may enable the operator to penetrate cavernous areas. The same dangers from stuck drill pipe and blowouts which attend the method in low pressure areas become even graver when using the method in drilling cavernous zones. Here again casing should be set as soon as the cavernous area is passed.

Use of Cement

The term cavernous as applied in the discussion of the use of cement to restore lost returns, includes both caverns and crevices. Crevices may be treated as caverns except in those cases in which the wall of the crevice approaches the vertical and deflects the drilling tools from the vertical. When this occurs, the crevice must be cemented as described below, if drilling is to continue.

In most instances the operator will find it desirable or imperative to correct a cavernous condition before he continues drilling. Common practice is to try plugging and bridging agents first, but if a truly cavernous condition exists, these materials rarely will help. Cavernous conditions indicate the use of gel type cement.

Of all materials, gel type cement is best adapted to filling or bridging caverns sufficiently to allow holes to be drilled through the cement plug. The use of neat cement to do the same job would require an enormously greater volume of slurry. The difference lies in the characteristics of gel type cement which give it the higher angle of repose. As described previously, the neat cement slurry flows to the lowest point of the cavern or crevice. Any increase in the water-cement ratio results in a thinner slurry which, naturally, flows a greater distance and results in a lesser thickness or fill-up per batch. Gel type cement mixed in the ratio of eight to ten pounds of gel material and ten to 12 gallons of water per sack of cement will produce a gelling cement having an angle of repose steeper than 45 degrees, which means that the cement will stack up in a cone-shaped mass when dumped through the drill pipe into a cavern. Mixing and placing the cement in batches, with an interval between batches long enough to allow the previous batch to set, will build a drillable cement cone from the floor to the ceiling of the cavern. The nature of the gel cement slurry is such that it resists dilution by water present in the cavern. After the cement job has bridged the cavern, restoring circulation, the operator can drill the cement and resume hole making. The procedure described above frequently will save a string of casing and shorten the total drilling time.

This discussion has indicated various types of lost returns and the characteristics of each which should enable the operator to classify the type which he encounters. This paper has described a number of materials and methods of using them to restore lost returns. Proper application of materials and methods will minimize the time and material required to overcome the troubles arising from this source.

As a final warning, the operator will do well to remember that continued pumping of the same kind of mud as that originally lost rarely brings about any degree of correction but will result only in the useless expenditure of time and materials.

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[3] Recommended Practice on Standard Field Procedure for Testing Drilling Fluids. API Code No. 29, July, 1942.
[4] Baroid Sales Division. Aquagel Cement for Oil Wells. Drilling Mud. November, 1943.
[5] Amarillo Daily News. June 4, 1931.

It's the *SIDES* of a V-BELT That Really Get the WEAR!

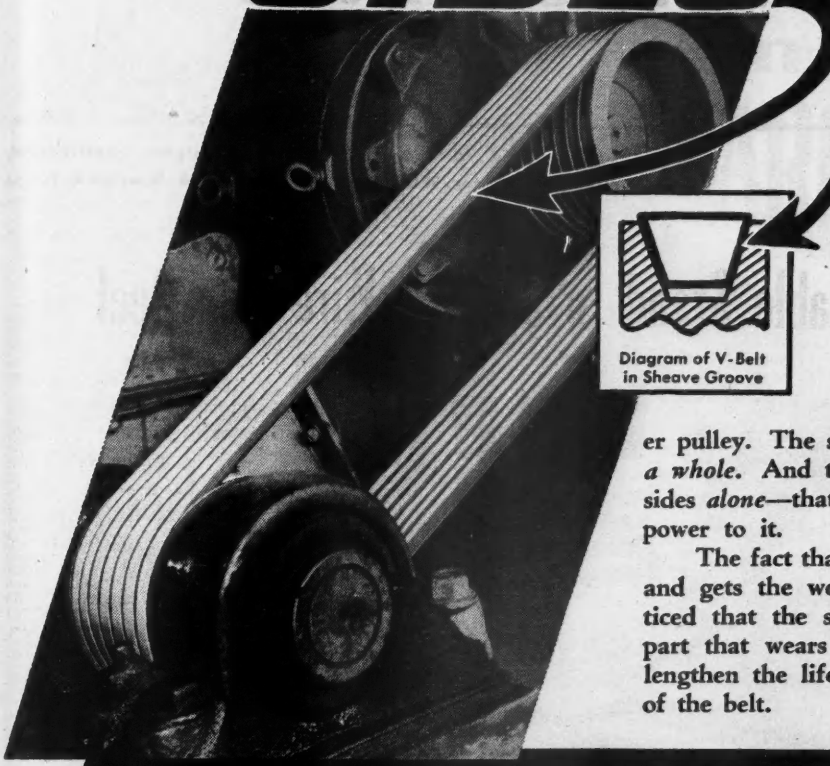

Diagram of V-Belt in Sheave Groove

Look at this diagram of a V-Belt in its sheave. You see at once that the *sides* of the belt do all the gripping on the pulley and get all the wear against the sheave-groove wall.

It's the *sides*, moreover, that pick up all the power delivered by the driver pulley. The sides *transmit* that power to the *belt as a whole.* And then, once more, its the sides—and the sides *alone*—that grip the driven pulley and *deliver* the power to it.

The fact that the *side* is the part that does the work and gets the wear explains why you have always noticed that the sidewall of the *ordinary* V-Belt is the part that wears out *first.* Naturally, then, when you lengthen the life of the sidewall you lengthen the life of the belt.

Now See How the CONCAVE SIDE... SAVES Sidewall Wear and Lengthens Belt Life!

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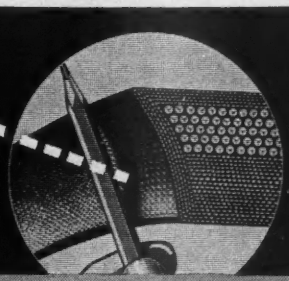

The simple diagrams on the right show exactly why the ordinary, *straight-sided* V-Belt gets excessive wear along the *middle of the sides.* They show also why the Concave Side *greatly reduces* sidewall wear in Gates Vulco Ropes. That is the simple reason why your Gates Vulco Ropes are giving you so much longer service than any straight-sided V-Belts can possibly give.

Fig. 1

Straight Sided V-Belt

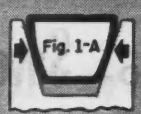

Fig. 1-A

How Straight Sided V-Belt Bulges When Bending Around Its Pulley

You can actually feel the bulging of a Straight-sided V-Belt by holding the sides between your finger and thumb and then bending the belt. Naturally, this bulging produces excessive wear along the middle of the sidewall as indicated by arrows.

Fig. 2

Gates V-Belt with Concave Sidewall

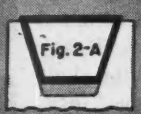

Fig. 2-A

Showing How Concave Side of Gates V-Belt Straightens to Make Perfect Fit in Sheave Groove When Belt is Bending Over Pulley.

No bulging against the sides of the sheave groove means that sidewall wear is evenly distributed over the full width of the sidewall—and that means much longer life for the belt!

Saving Sidewall Wear is MORE IMPORTANT NOW Than Ever Before!

Now that Gates SPECIALIZED Research has resulted in Super Vulco Ropes capable of carrying much heavier loads—fully 40% higher horsepower ratings—the sidewall of the belt is called upon to do even more work in transmitting these heavier loads to the pulley. Naturally, with heavier loading on the sidewall, the life-prolonging Concave Side is more important now than ever before!

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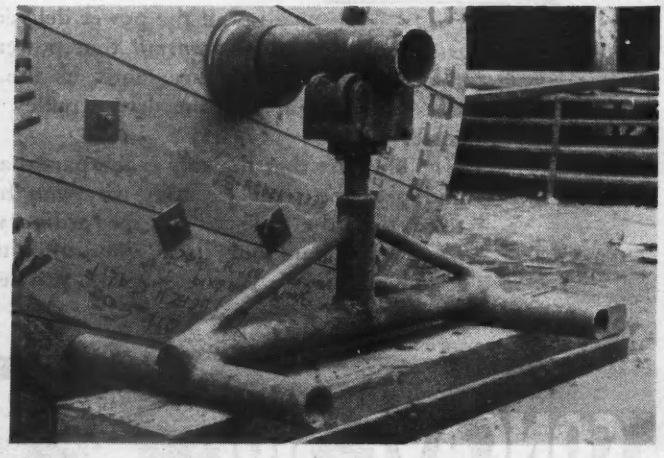
HOW TO—Construct Adjustable Stand to Support Wire Line Reel

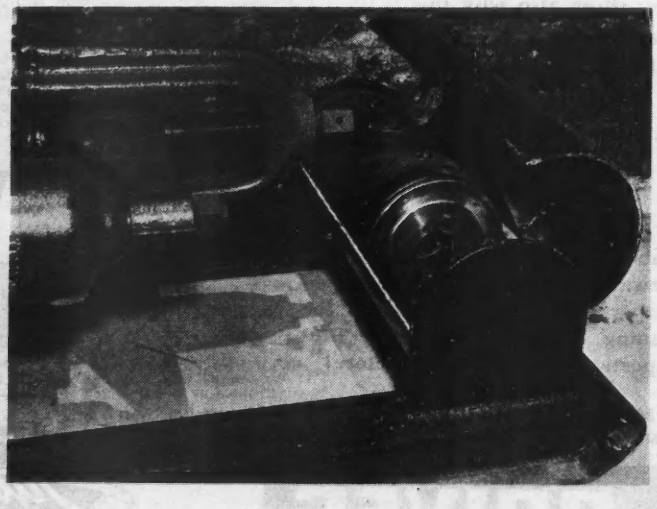
To eliminate the need for a rigging crane to lift a reel of heavy drilling line to an unspooling stand and to remove a hazard incidental to the falling of the reel from a considerable height, one drilling contractor has constructed a relatively simple stand to support the reel and one which can be adjusted for height. The base of the stand was made of extra heavy two-inch tubing using two nipples welded to a right angle connector with a short riser attached midway between the feet. Diagonal braces support the riser which contains the threaded nut of a screw jack, into which the adjusting stem of the jack is inserted.



Head of the jack was inserted into a heavy channel iron carrier containing double edge rollers upon which the spool shaft rotates. To use this stand, the reel of wire line is rolled to the desired location and the shaft inserted through the hub of the reel. The jacks or reel stands are placed on each side of the reel with timber cribbing employed to provide the necessary low adjustment bringing the supporting roller heads against the reel shaft. With jack bars, the load is lifted until the reel is free, in which position the line can easily be unspooled. The double edge rollers also provide smooth rotation of the reel so that the wire line will feed smoothly to the drum of the rig without intermittent jerking, frequently the cause of kinking.

HOW TO—Save Time in Transporting Blowout Preventer and Rams

Time required to move drilling equipment from one location to another has been considerably reduced through the use of skid-mounted equipment. Heavy loads placed on skids can easily be "sucked" up onto the bed of moving trucks and can with equal ease be dragged off the truck bed. Skids also make it possible to handle the equipment without damage.



Protection and ease of handling heavy blowout preventers resulted from skid-mounting this important piece of drilling equipment. The skid was made from six-inch I-beam stock to dimensions to fit the particular size blowout preventer used. The skid is slightly wider than the greatest width and extends about two feet beyond the ends of the preventer. Each end was cross-braced with heavy four-inch pipe, and a platform of oak timbers was bolted across the center of the skid on which to mount the preventer.

Across each end were welded cylindrical tool boxes. The tool boxes, actually chests for housing the different size preventer rams, were made from 16-inch casing split longitudinally. The top section was hinged on the outboard edges and equipped with hasp and handle. One set of rams is carried in the preventer, while two additional sets, each of different sizes, are carried in each chest. In this manner, the rams as well as the preventer, are fully protected during rig moves, eliminating repairs and replacement of parts.

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This is just one of a number of Silverlink roller chain drives of this type that Link-Belt engineers have helped put in operation for major oil companies and drilling contractors.

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Several of these barge job Silverlink roller chain installations have been working for over two years without a sign of trouble. Others have been in service a shorter period, with equal satisfaction.

Dependability of this kind is just another reason why progressive operators everywhere know they can rely on the trouble-free performance of Link-Belt Silverlink roller chain, proved through years of unfailing service in oilfields everywhere. Specify Silverlink. It's the result of more than 70 years of continuous chain improvement.

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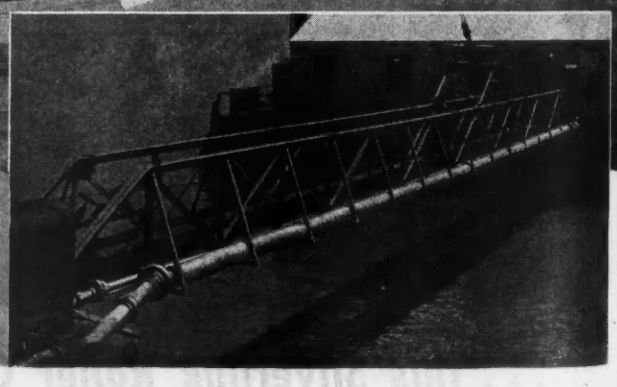
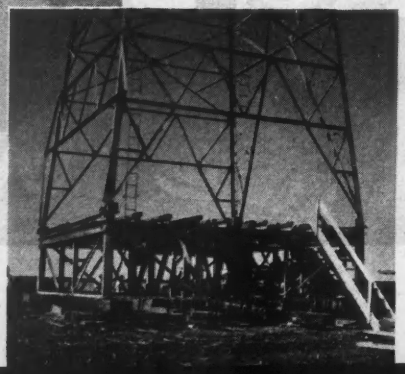
Drilling barge equipped with 136' high, 30' base, Emsco Type 18AR derrick. Note Emsco gin pole assembly, quadruple safety platform and 1st girt landing platform. Inset at right shows Emsco walkway used to connect drilling barge with boiler barge. Walkway is hinged permitting it to be raised during moving or when rough weather is encountered. Walkway supports pipe lines connecting barges.

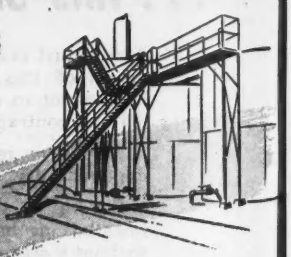


Looking up 136', Emsco 18AR derrick equipped with Emsco 14GP, 16,600 lb. capacity gin pole assembly. Also note Emsco tong hangers and quadruple safety platform.

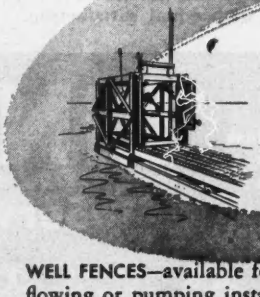


MISCELLANEOUS STRUCTURAL PRODUCTS

Rigging up an Emsco derrick on a 10' high, Emsco 60HX substructure. This substructure is designed for deep drilling operations requiring heavy, bulky blowout equipment and racking of large amounts of pipe on derrick floor. It is well suited for skidding operations.



TANK WALKWAYS—tank and gun barrel walkways and stairs are fabricated to meet specific requirements. Hot dip galvanizing insures long life and low maintenance.



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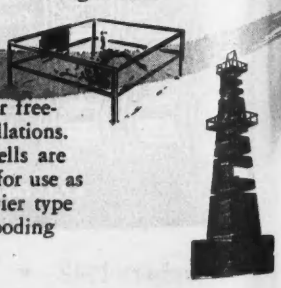
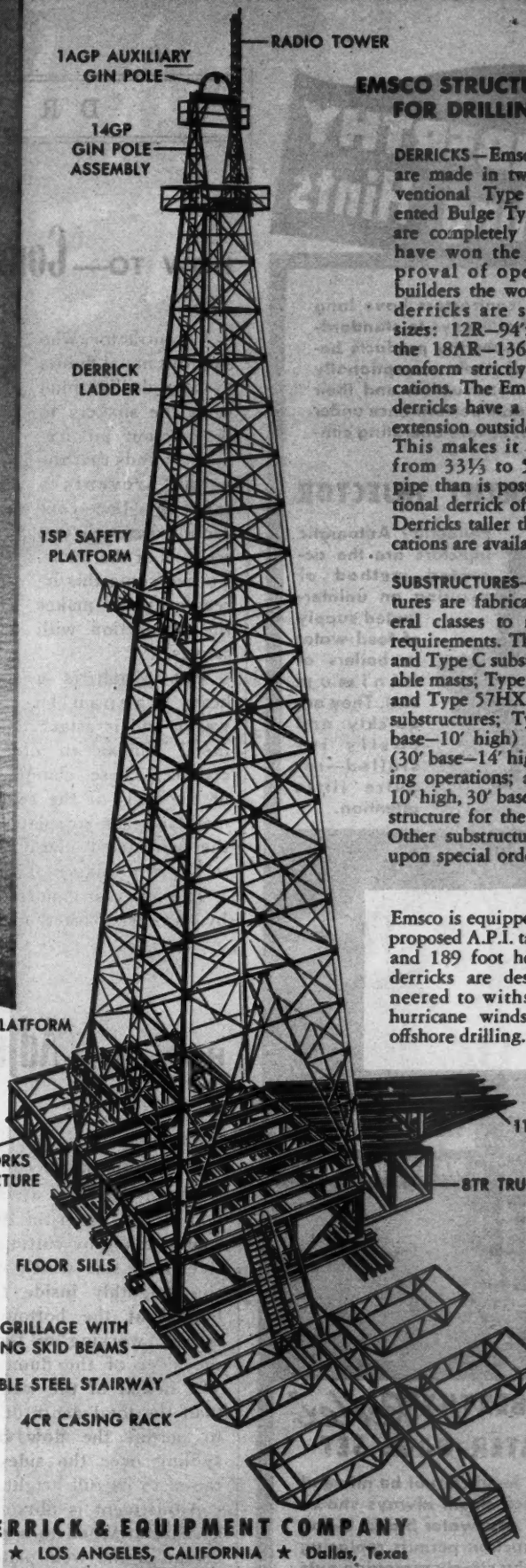


WELL FENCES—available for free-flowing or pumping installations. Fences for free-flowing wells are of two types: a light unit for use as a cattle guard; and a heavier type for locations subject to flooding to protect well head from floating drift.

EMSCO DERRICKS AND SUBSTRUCTURES MEET ALL DRILLING REQUIREMENTS

Aerial view of offshore drilling location using Emsco 18AR, 136′ derrick and other structural accessories.



EMSCO STRUCTURAL ITEMS FOR DRILLING RIGS

DERRICKS—Emsco Steel Derricks are made in two styles—the conventional Type R and the patented Bulge Type R. Both styles are completely field proven and have won the unqualified approval of operators and rig builders the world over. Type R derricks are stocked in three sizes: 12R—94′; 17R—129′; and the 18AR—136′. These derricks conform strictly to A.P.I. specifications. The Emsco Bulge Type R derricks have a special "set-back" extension outside the derrick legs. This makes it possible to rack from 33⅓ to 50 percent more pipe than is possible in a conventional derrick of the same height. Derricks taller than A.P.I. specifications are available on order.

SUBSTRUCTURES—Emsco substructures are fabricated in four general classes to meet all drilling requirements. These are: Type M and Type C substructures for portable masts; Type 53HX (24′ base) and Type 57HX (30′ base) A.P.I. substructures; Type 60 HX (30′ base—10′ high) and Type 75HX (30′ base—14′ high) for deep drilling operations; and Type 80HX, 10′ high, 30′ base trussed type substructure for the deepest drilling. Other substructures are available upon special order.

Emsco is equipped to fabricate the proposed A.P.I. tall derricks in 140 and 189 foot heights. These tall derricks are designed and engineered to withstand the severe hurricane winds encountered in offshore drilling.

PARTIAL LIST OF EMSCO STRUCTURAL PRODUCTS • A.P.I. DERRICKS • SPECIAL DERRICKS A.P.I. SUBSTRUCTURES • PORTABLE MASTS AND SUBSTRUCTURES • CUSTOM BUILT SUBSTRUCTURES • ENGINE SUBSTRUCTURES • GIN POLES • AUXILIARY GIN POLES • SAFETY PLATFORMS • TUBING BOARDS • TONG HANGERS • DERRICK LADDERS • DERRICK LANDING PLATFORMS • DEADLINE ANCHORS • STEEL STAIRWAYS • TRUCK RAMPS • TOOL RAMPS CASING RACKS • KELLY SLIDES • BARGE WALKWAYS • BOAT LANDINGS • SAFETY GUARDS • SLUSH PIT SUCTION SCREENS SWAMP WALKWAYS • COMBINATION WELL GUARD, BOAT LANDING AND GUIDE CHUTE • WELL FENCES • PUMPING UNIT FENCES • TANK WALKWAYS • SEPARATOR TOWERS RADIO TOWERS • TRANSMISSION TOWERS • FLOODLIGHT AND LOOKOUT TOWERS • FLARE TOWERS • WATER TANK TOWERS • SUBSTATION STRUCTURES.

ASK YOUR NEAREST EMSCO-CONTINENTAL REPRESENTATIVE FOR DETAILED INFORMATION

EMSCO DERRICK & EQUIPMENT COMPANY
Houston, Texas ★ LOS ANGELES, CALIFORNIA ★ Dallas, Texas

EMSCO

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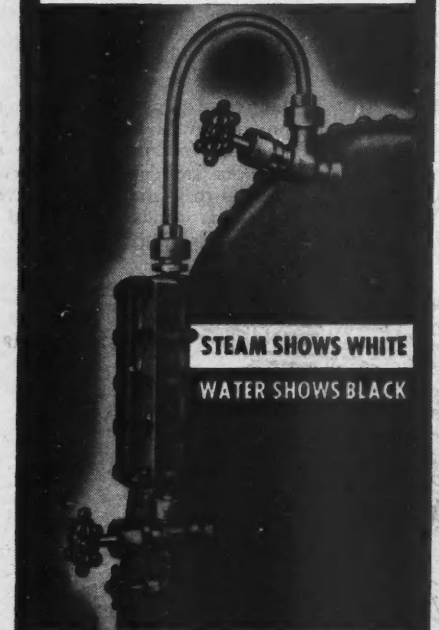
PENBERTHY Drilling Hints

Drilling contractors have long found that it pays to standardize on Penberthy products because of their exceptionally rugged construction and their dependable performance under the most severe operating conditions.

PENBERTHY INJECTOR

Penberthy Automatic Injectors are the accepted method of assuring an uninterrupted supply of feed water to boilers at minimum cost. They are quickly and easily installed—require little attention.

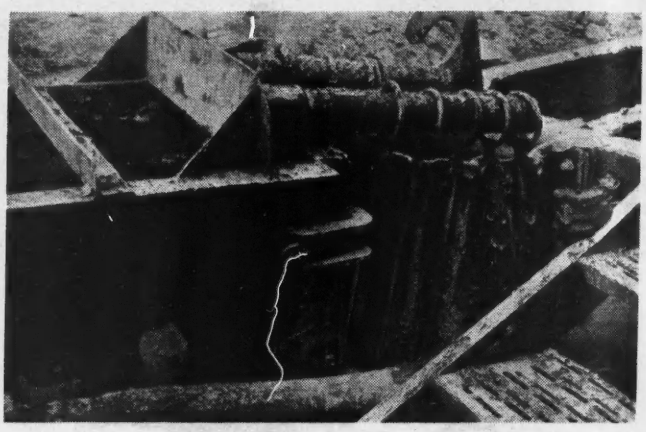


PENBERTHY "Reflex" WATER GAGE SET

Water level cannot be misread because steam always shows white and water black. U-Bolt construction permits replacing glass by simply removing nuts on face of gage... unnecessary to work between gage and boiler. 3277-D

PENBERTHY INJECTOR CO.
Detroit 2, Mich.
Canadian Plant — Windsor, Ontario

HOW TO—Connect Mud Flumes With Canvas



A contractor who employs metal flumes to carry drilling mud from the shakers to the suction pit frequently finds that the terrain prevents a straight line connection between two sections of the flume. To overcome this irregularity, he makes the connection with canvas.

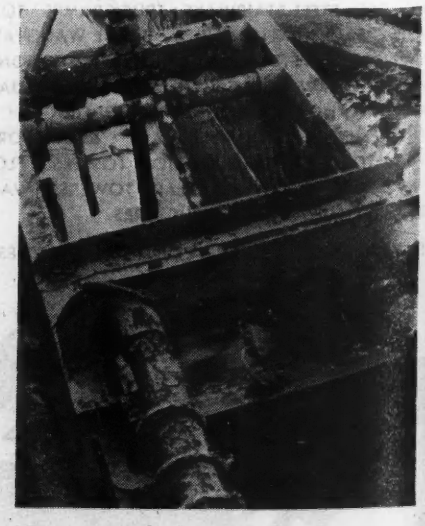
The cloth is a heavy tarpaulin weave and is attached to flat pieces of metal similar to old fashioned belt clamps. These clamps are shaped to fit the ends of the two flume sections, matching similar plates of metal with the two joined snugly by a binder lock to prevent leaking at the joint.

The canvas connector is supported by a steel basket made by using a series of steel rods shaped to carry the canvas with a flat floor and straight sides to match the size of the flumes. The weight of the canvas and the flowing mud are supported by the basket which in turn is connected to two pipe nipples screwed into collars carried by a header at the end of the upstream flume section.

HOW TO—Adjust Level in Steel Mud Trough

An adjustable weir set into the steel mud trough has been found beneficial for the purpose of assisting the separation of sand from the drilling fluid. The weir is made by cutting a sheet of tank steel to a size which will permit it to slip smoothly inside the flume. It is hinged at the bottom with pins attached, working in ferrules tacked to the sides of the flume near the floor. The height of the weir is slightly less than the total depth of the flume so as to permit the flow of mud without spilling over the sides if the weir is raised to its full height.

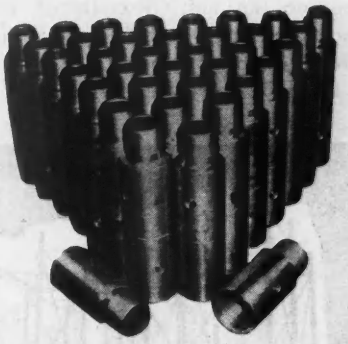
Adjustment is obtained by means of a chain attached to a ring in the upper center of the weir plate and connected to a shaft approximately three feet upstream. This shaft works freely in bearings, one of which is drilled to match a hole in the shaft for locking in position where needed after raising or lowering the weir to control the flow of mud. When the weir is raised to back mud up onto the flume, a period of quiescence is established that permits sand and heavy particles not separated by the shale shaker to settle from the circulation.



Dumping the accumulation is done with a long stem drop-out valve fitted to the floor of the flume.

You asked for SAFETY... ...here it is!

For the SAFE use of tubing in well workovers, the HOMCO tubing tool joint provides the ability to accomplish this. For the details, see page 1793 of the 1948 Composite Catalog.



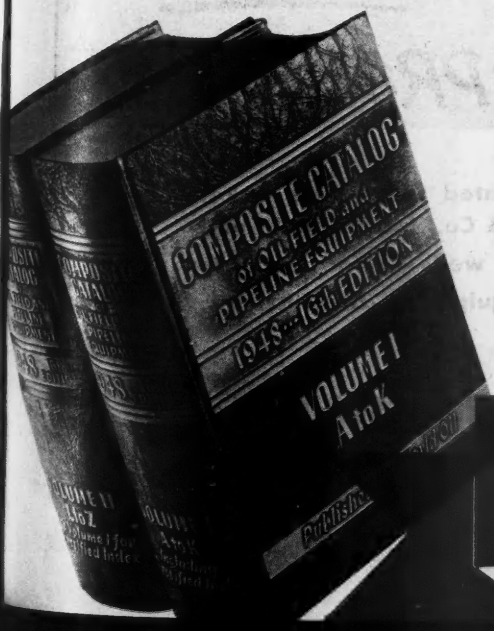
HOMCO SAFETY LOCK LIFT PLUG

For use with drill collars, casing, drill pipe and all flush jointed pipe. Can be made-up hand tight and will not back-off until releasing wrench is inserted. For details, see page 1792 of the 1948 Composite Catalog.

HOMCO SUPER SAFETY JOINT

This rugged, dependable safety joint is used in drilling and fishing operations. The specifications may be found on page 1790 of the Composite Catalog.

DETAILS OF OTHER HOMCO TOOLS AND SERVICES CAN BE FOUND ON PAGES 1777 THROUGH 1799 IN THE LATEST COMPOSITE CATALOG



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EMERGENCY JACK MODEL 310-A

Lifts vertically, lifts or pushes at any angle!

Lifts *full 15 ton capacity* on the machine serrated toe, on the cap, on the auxiliary cap shoe or on any link of 5' chain!

Double lever socket!

14" lift!

Meets emergency jacking needs in the oil field . . . with power, safety and easy operation!

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GERONIMO will stand hardest wear and give unfailing protection to refinery and derrick men whose lives are endangered by fire, escaping gases or other hazards.

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PERRY, OKLAHOMA

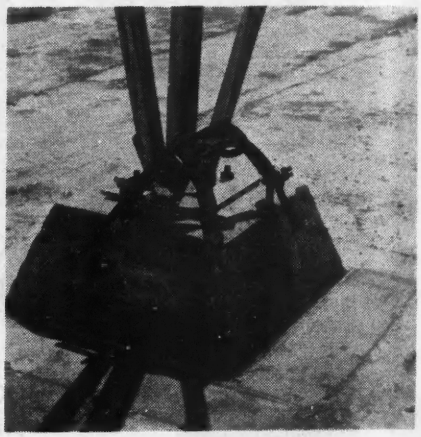
DRILLING HINTS

HOW TO—Safely Anchor Service Deadline

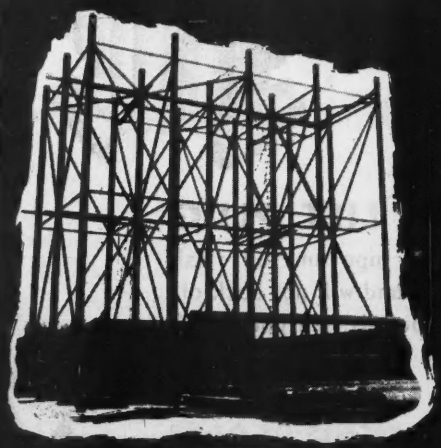
By fixing a U-shaped piece inside the form before the corner foundation for the derrick is poured, with the ends of the "U" inside the derrick area and close to the edge of the top of the base, one producer equips each well with means for anchoring the service deadline or rod holdbacks.

The U is formed from two-inch pipe, with a temporary plug of rags or wood in each end to prevent the pipe from filling with concrete or grout as the form is filled. Even if the pipe rusts out, the curved recess within the concrete is available for use. The anchor is formed by threading a short section of wire line through the recess and forming a loop of the desired size by tying or clamping the free ends. The wire line may be passed through the eye of the snatch block for the winch service line, or the unit, if equipped with a hook and safety catch, may be placed after the loop is formed.

The wire is replaced simply by pulling it through the U-shaped pipe and another for replacement threaded through.



This type of anchor eliminates the hazard present when an inverted U of steel is cast into the concrete and corrosion weakens the metal at or below the face of the concrete.



AVONDALE'S ANSWER

AVONDALE has fabricated these pipe jackets for J. Ray McDermott & Co., Inc., to build platforms for drilling oil wells in the Gulf. For dependable marine equipment construction . . . Consult

AVONDALE MARINE WAYS, Inc.

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Mailing Address: Westwego, La.

Main Plant: Avondale, La.
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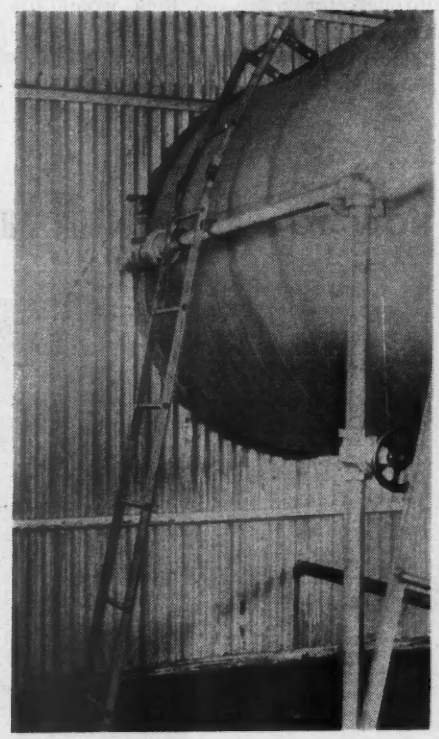
HOW TO—Insure Safety in Boiler Inspection

It is frequently necessary that the fireman climb atop oil country boilers to open or close valves, to inspect and service the unit, as well as to paint the insulation, etc. These jobs were made safe by the fabrication of a slip-proof ladder which provided a convenience to those who performed these tasks.

A steel ladder, similar to those used on derricks, was used and cut to a length just slightly longer than the height of the boiler. At the mid point of the boiler, the ladder was bent at a slight angle with the aid of a welder's torch. This angle permitted the ladder to lean closer to the boiler. As a brace and additional support, a wide "U" section was bolted to the top of the ladder which permitted it to rest on the shell of the boiler without damage. "U" bolts welded to the ladder where it crossed the feed water line secured the two together to provide a safe scaffolding for the fireman. The ladder is sturdy and can easily be detached if the need arises.



HOW TO—Store Wire Line Used for Railing

It is more or less standard practice on many drilling rigs to enclose the derrick floor and engine platform with wire line to serve as a safety railing. Various methods have been used to attach the wire line to the corner pipe supports. A convenient method for handling the wire line used for such safety railing around the derrick floor is illustrated.

The device for storing and tightening the wire line has been unitized with the terminating pipe support. Two small shop-made reels have been mounted to the pipe support by means of two wide steel plate brackets. The lower reel carries the line for the bottom safety railing and is mounted in a similar manner to that of the top reel.

Each reel is controlled by a solid bar steel handle which also serves as an axle. It is threaded at one end to permit tightening of the axle and thereby adding friction to prevent the reel from

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Proved Principle of
"COLLOIDAL CONTROL"
of Boiler Scale and Corrosion.

It constitutes the highest development in the automatic removal and prevention of boiler scale and corrosion. It does materially cut maintenance costs.

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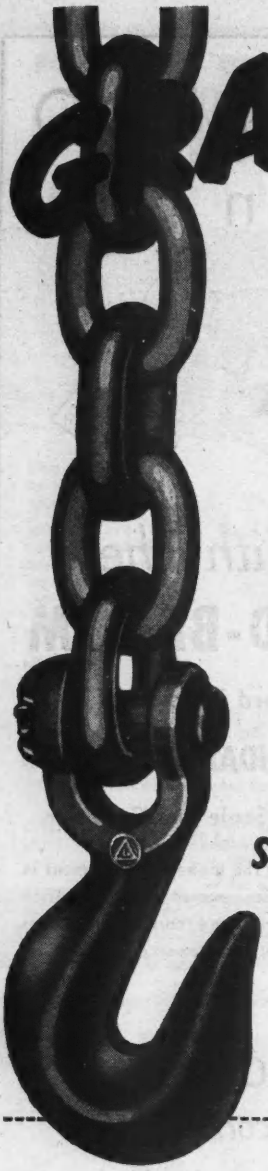


GRAB ...THIS NEW CLEVIS GRAB HOOK for Speed, Safety, Simplicity

Here's a new one—a rugged, heat-treated, forged hook with a jaw that's quickly attached to any chain.

Slip the pin through the clevis; Spread the cotter

. . . and you've made a better, stronger connection in nothing flat. Supersafe, too—forged housing protects workers from projecting cotter pin.

Laughlin Clevis Grab Hooks do away with shackling . . . cold-shutting . . . cutting, bending and rewelding the chain. Easily changed from job to job.

Send for information . . . and Laughlin's data book of industrial fittings — Catalog #140. THE THOMAS LAUGHLIN COMPANY, DEPT. 23, PORTLAND 6, MAINE.

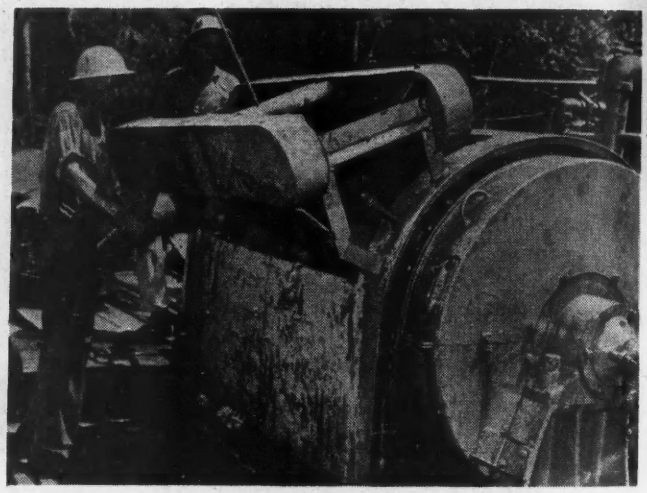
LAUGHLIN

THE MOST COMPLETE LINE OF DROP-FORGED WIRE ROPE AND CHAIN FITTINGS

rotating. The handle is bent to provide sufficient leverage for turning and tightening up the railing line. Dead end of the wire line is attached to the reel through a small hole cut in the drum of the reel. The line is merely threaded through the hole and then wound on the reel.

During rig moves, the railing line is unbolted at the opposite end from that of the reel and then wound up and stored on the reel for transporting to the next location. In this manner, the proper length of line is always assured for the next location, and is available on the reel to simplify setting up this part of the rig. Each pipe support is firmly anchored to the wooden derrick floor by four bolts which are attached to a wide square flange welded to the upright.

HOW TO—Safely Guide Sand Line During Winding



Considerable improvement in safety of operation and a definite reduction in physical effort resulted from an ingenious manually-operated wire line level winder. The device has been used successfully in guiding the sand line as it is reeled up on the core reel to prevent fouling or balling up. The operator of the level winder can remain a safe distance from the sand line as it is being hauled in and thereby is in a much safer position in case of a wire line break.

The device consists of two endless roller chains geared to a crank which is operated by one of the crew. The wire line is guided by two hardened steel rollers which are supported at either end by bearings which are affixed to rollers. These rollers ride back and forth across the front of the coring reel on two pipe carriages bolted at either end of the device. The rollers are guided across the pipe carriages by endless roller chains. The wire line guides are attached to the endless chain by means of a single bolt which is threaded through an open link in the chain and bolted to the rollers.

Action of both roller chains are synchronized by an axle on each end of which are mounted chain sprockets. The crank is attached to another chain sprocket and is geared to the endless roller chains through a third endless chain which rotates a sprocket on the axle. Chain guards have been added to prevent crewmen's clothing from being tangled in the chains, and the unit has been welded by means of brackets to the wire line unit. The operator of the wire line guide can guide the line evenly across the reel with added safety and accuracy.

MASS PRODUCTION?

NO!

NOT IN OIL EXPLORATION!

CAREFULLY INDIVIDUALIZED GEOPHYSICAL WORK ADAPTED TO THE FACTS IN EACH PARTICULAR CASE, BOTH IN THE FIELD AND IN THE OFFICE.

KLAUS EXPLORATION CO.

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DRILL 4,000 FEET
At Less Cost PER FOOT

UNIT RIG Model U-34

The U-34 was designed for shallow well drilling at less cost per foot. It is now living up to its purpose in action in many fields throughout the country. See your supply company or write to Tulsa for more information.

The U-34 has the same fine engineering and workmanship that goes into the well-known Unit Rig Model U-15. It can't be beat for ruggedness, speed and performance.

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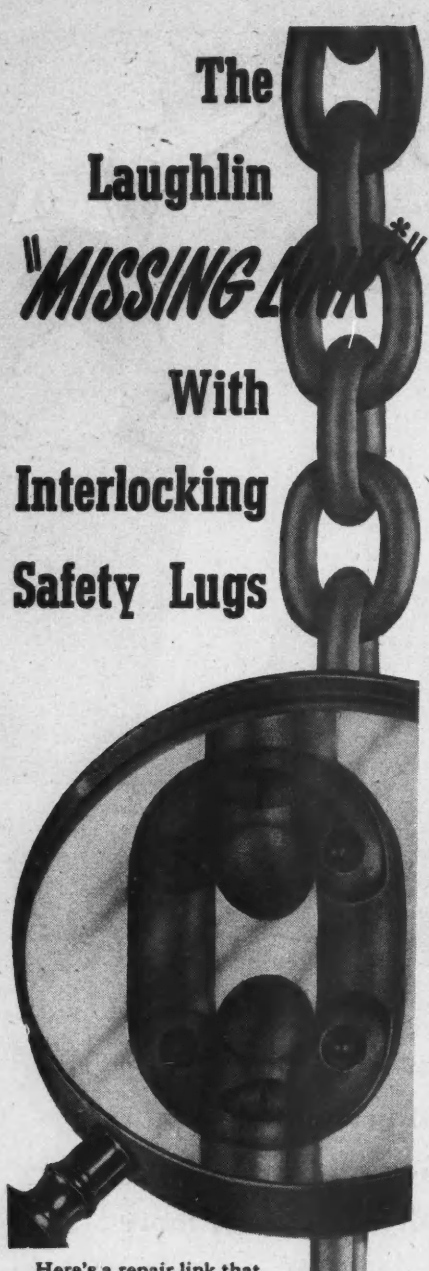
The Laughlin "MISSING LINK"* With Interlocking Safety Lugs



Here's a repair link that locks on to *stay*... is stronger than proof coil chain itself... is applied in a jiffy! Specify Laughlin "Missing Links"... get extra security at real savings in time and money. All sizes from 3/16" to 1 1/8", inclusive. Write for Catalog 140... the data book of the fitting industry. Address THE THOMAS LAUGHLIN CO., Dept. 23, Portland 6, Maine.

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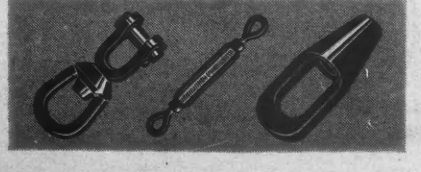
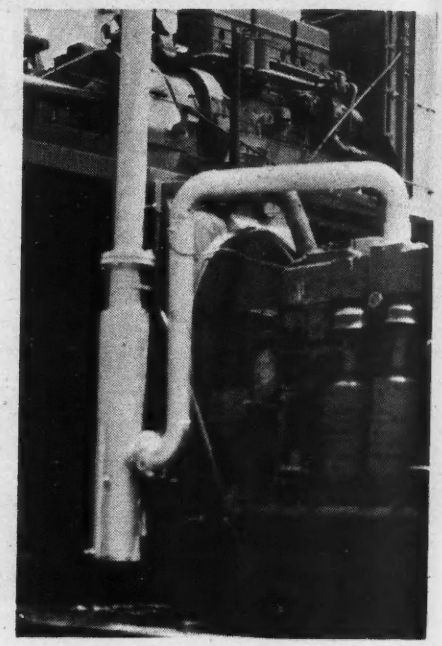
LAUGHLIN

THE MOST COMPLETE LINE OF DROP-FORGED WIRE ROPE AND CHAIN FITTINGS



HOW TO—Automatically Drain Muffler Water

A contractor who moves his tools frequently has equipped the mud pump engines with exhaust pipes and mufflers that may remain in place when the engine is picked up, reset, or transported by truck. The muffler is attached vertically to the channel iron support and guard for the radiator while the extension "tail pipe" is flanged for removal when necessary.



To quench the heat and flame of the exhaust gas, water is injected into the exhaust line between the engine and the muffler. Going one step farther, this contractor provides for automatic siphoning of excess water from the lower head of the muffler. The siphon is a piece of one-inch pipe inserted through a hole near the base of the muffler so that the inner part will reach almost to the bottom head. A long tee, also made of one-inch pipe, is welded to the short nipple extending through the shell of the muffler so that the pulsations of the engine will automatically expel the water.

If the engine should be shut down with the quench water left flowing, it will automatically siphon out when it reaches the overflow level provided by the one-inch pipe inserted through the walls. This automatic siphon prevents water from backing up into the exhaust manifold and flooding the engine and also prevents a back pressure on the exhaust valves should the engine be started with a muffler full of water.

HOW TO—Display Drilling Crew Safety Record

Drilling rig safety programs are given more emphasis now than ever before throughout the industry. Safety now holds a place on an equal plane with design and operating techniques. Safety departments have been established for years in drilling departments and by drilling contractors in an attempt to eliminate unnecessary accidents on the drilling rig. Special protective equipment and planned work facilitate this program. But even all this is not enough. Other methods of making drilling crews safety minded have been employed.

To further place emphasis on its safety program, one company set up the sign shown at the top of the stairway to the rig floor, with these words, "Up these steps to this derrick floor safe workmen have gone . . . days without loss of time . . . . the crew." When the number of days since the last lost-time accident are clearly indicated, the sign becomes a constant reminder to crew members every time they ascend the stairway. This is but one of many means of keeping the man on the rig on his guard as far as safety is concerned. The notice stands out as an impressive record to visitors as well as company officials.

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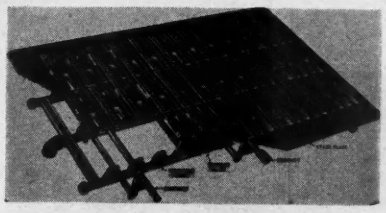

VOLCANO SUPERIOR GAS BURNERS

These burners derive their higher efficiency and longer life from such features as: All-steel construction; Burner heads with double barrel shank and double mixer are equivalent to two ordinary burner heads; Slight H-shape of head assures more perfect combustion by proper circulation of secondary air; series of heads on triple manifold covers approximately entire firebox area. For superior efficiency, specify Volcano Superior Gas Burners.

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Quality Pumping Equipment, Swage Nipples, Bull Plugs, Welding Fittings, etc.

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OIC VALVES, Bronze, Iron and Steel, for all purposes. "Oh! I See Lower Costs with OIC."

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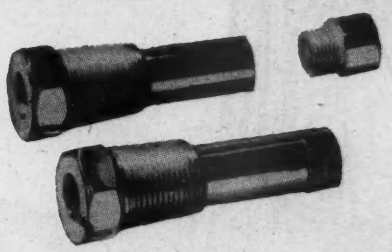
Seamless Welding Fittings



Oseco High Pressure Fusible Plug

Unique design permits replacement of inserts instead of the entire plug. OSECO "Silver Top" plugs are made in all standard sizes of best quality bronze, under A.S.M.E. specifications, for 300 and 350 lb. oil field boilers. They can also be furnished in Monel or Stainless Steel.

Below Your Costs

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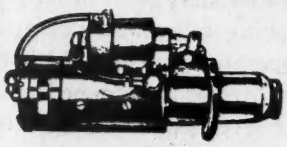
"71" DIESEL GM PARTS



STARTING MOTOR AND SOLENOID ASSEMBLY
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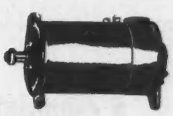
- 12 Volt, 900 Amps, 800 R P M
- Rotates clockwise
- Immediate delivery from stock

GENERATOR ASSEMBLY
- Delco Remy part No. 1102963
- 12 Volt variable speed
- Immediate delivery from stock



These and many more

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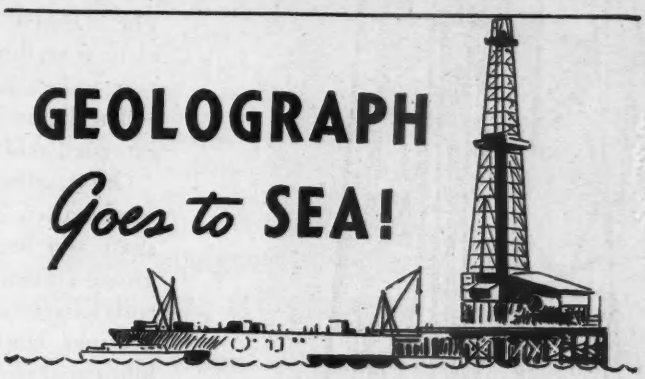

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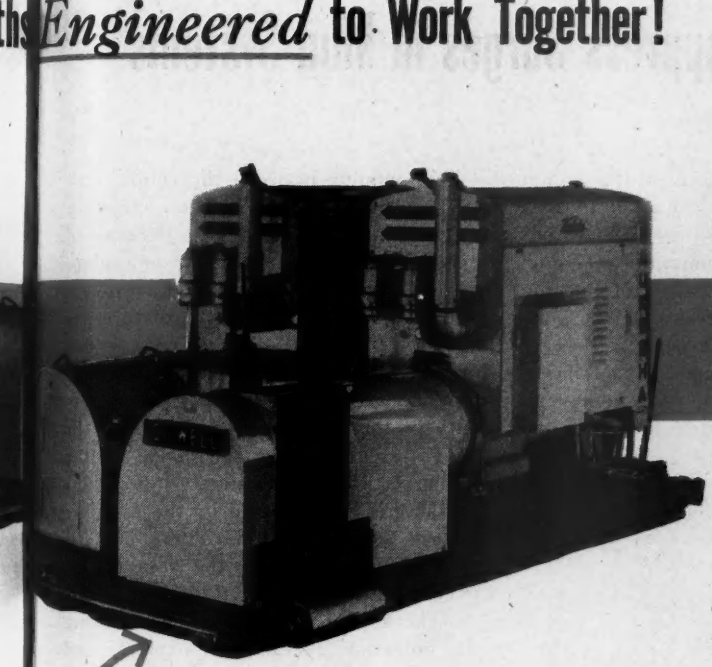

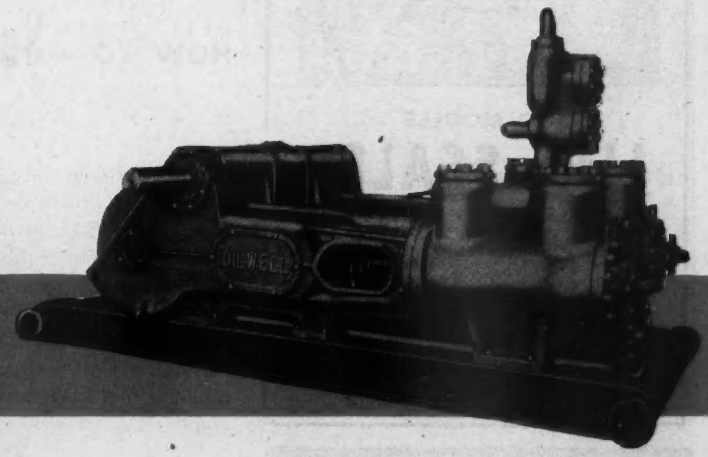

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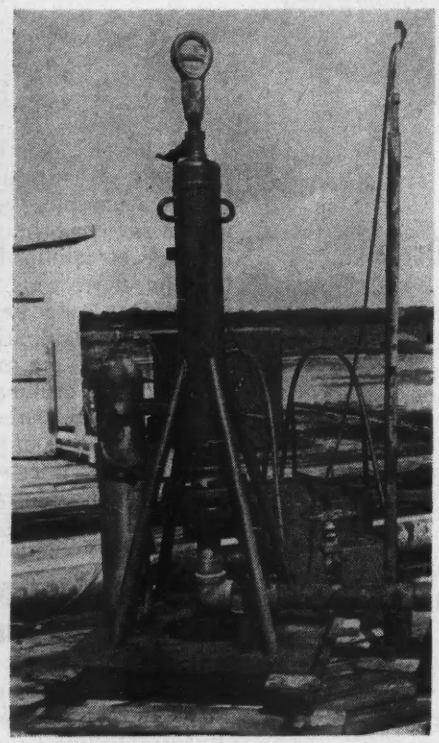
HOW TO—Suppress Surges in Mud Systems

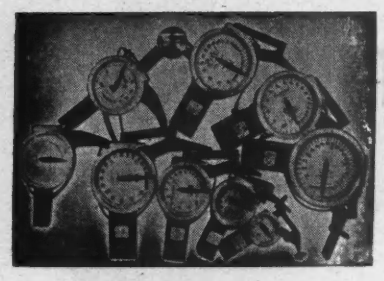
The continual pulsation of the drilling mud under pressure is known to have damaging effects to the pipe fittings, hose, and other equipment in the mud system. Excessive vibration of the mud line is capable of breaking welds and loosening flange joints, as well as resulting in other damages. While all modern, high-pressure mud pumps are equipped with air surge chambers, the



degree of absorbing the pulsation is not sufficient. The pressure surge curve can be smoothed considerably by including in the system a pressurized chamber such as that illustrated.

The device shown is connected into the discharge mud line leading to the stand pipe. It merely absorbs the peak pressures and fills in the low gaps. Inside the vertical high-pressure chamber is an elongated rubber balloon smaller than the inside diameter of the chamber. The rubber balloon is flanged at one end so that it fits between the lower flange joint shown. The four-inch line leading from the bottom of the device ties into the mud line through a tee fitting.

The annulus between the rubber balloon and the inside walls of the chamber are pressurized with a gas. Because of its elasticity, nitrogen has proven adaptable for this service. The gas is fed into the chamber through pressure reducing valves and adequate connections to the upper section of the unit. To the top of the chamber is added a heavy-duty pressure gauge. Pressure from the mud system charges the inside of the rubber balloon from the bottom. This pressure is counteracted by the pressure on the outside of the balloon, i.e., the pressure of the gas in the annulus between the balloon and the walls of the vessel. As the pressure varies during the pulsation, the balloon expands and contracts against the gas-filled annulus. In this manner, much of the pulsation in the mud line can be eliminated.



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Technique for Velocity Error Corrections

By J. L. KEZELER

SINCE THE GROUND velocities are the unknown and very crux of the seismograph technique, an accurate method of measuring these velocities has been developed and is described in this article.

A TECHNIQUE designed to eliminate errors in velocity determinations which may previously have resulted during the interpretation of a geophysical survey is now being used effectively in the Mid-Continent area. The technique is a "followup" tool which enables the geophysicist or operator to confirm or correct velocity readings for geophysical work performed previous to the drilling of a prospect. The work is undertaken during the actual drilling of a test and consists of periodic seismic readings obtained by utilizing geophones which are let down the bore hole and which record velocities resulting from the explosion of seismic shots set off at predetermined intervals from the well. The velocity corrections are then used against the original geophysical interpretation and may determine the advisability of discontinuing future drilling since they may reveal that a supposed anomaly actually does not exist as originally predicated due to lack of primary velocity determination. This application of the technique may result in substantial savings on drilling by proving beforehand that further operations are inadvisable due to lack of structure or because the producing horizon is too deep for economic exploitation.

Velocity Defined

Before describing the technique and its place in the oil industry, a brief description of the term "velocity" and the part it plays in everyday life may result in a clearer understanding of the part which the determination of velocity accuracy is now playing in oil exploration.

Webster defines velocity as: "Quickness of motion, swiftness; speed; celerity; rapidity; such as the velocity of the wind, a bullet, light, sound." Mechanically speaking, velocity is the time rate of motion, especially in a given direction and sense. Average velocity equals the total distance passed over, divided by the amount of time taken.

About the Author

J. L. KEZELER graduated from Texas A&M College in 1930 with a degree in electrical engineering. He worked two years with RCA-Victor Company in the engineering department, 13 months being spent in connection with television research development. He was one year with McCollum Exploration Company doing research and development work on geophysical equipment and then joined Seismograph Service Corporation where he eventually became supervisor in charge of recording equipment and observers. About two years ago he formed Key Velocities, Inc., Tulsa.

For example, the "velocity" or number of words per minute at which the reader skims through this article will determine how long it takes him to reach the end of it. The velocity at which he eats his food may determine whether or not he may suffer from indigestion. Time, by the clock, depends upon the velocity at which the hands sweep around its face. Change of seasons, night and day, and other natural phenomena depend upon the velocity at which the earth and other heavenly bodies move. The velocity at which a persons crosses the street and that at which an oncoming vehicle is moving may determine whether or not an accident occurs. In effect, "velocity" plays an unending part in everyday life. In geophysics, it plays a vital role and its accuracy is essential for the most successful interpretation of structural conditions, a most important condition in exploring for oil and gas reserves.

For those not familiar with seismograph work it is hoped the following will explain the need for the measuring of velocity of the travel of energy through the ground and what relationship such a measurement has in oil exploration.

For many years the seismograph, responding to earth vibrations caused by a charge of dynamite, has been used as a means of exploration for subsurface structures favorable to oil accumulation. In such oil exploration work a large number of measurements of times that are required for energy to travel from an explosion near the surface to some subsurface bed and back to the surface are used in mapping the structures. If the velocity at which this energy travels through the ground is known, then it is

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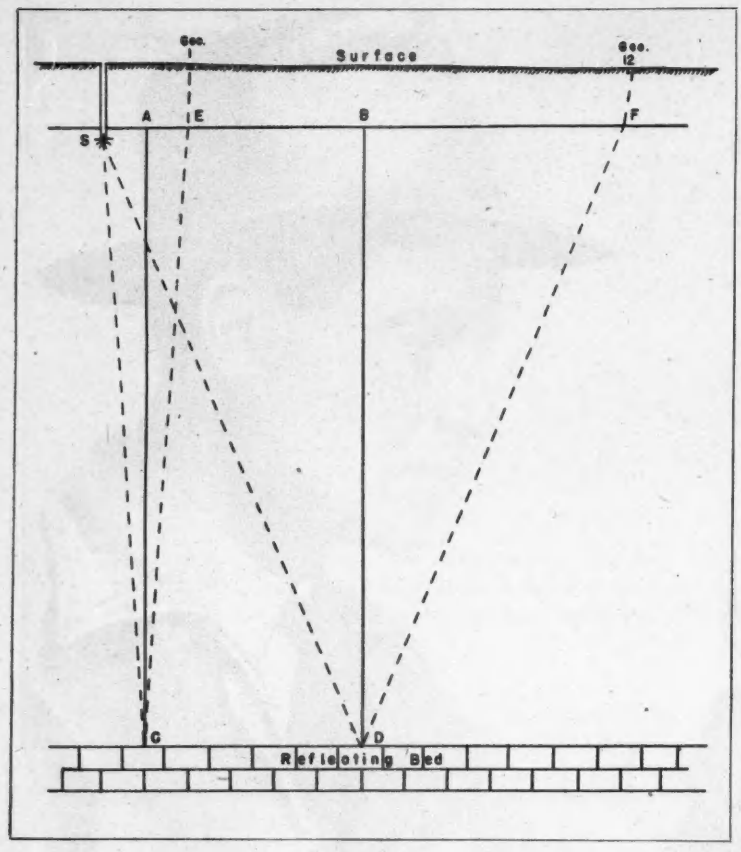

FIGURE 1

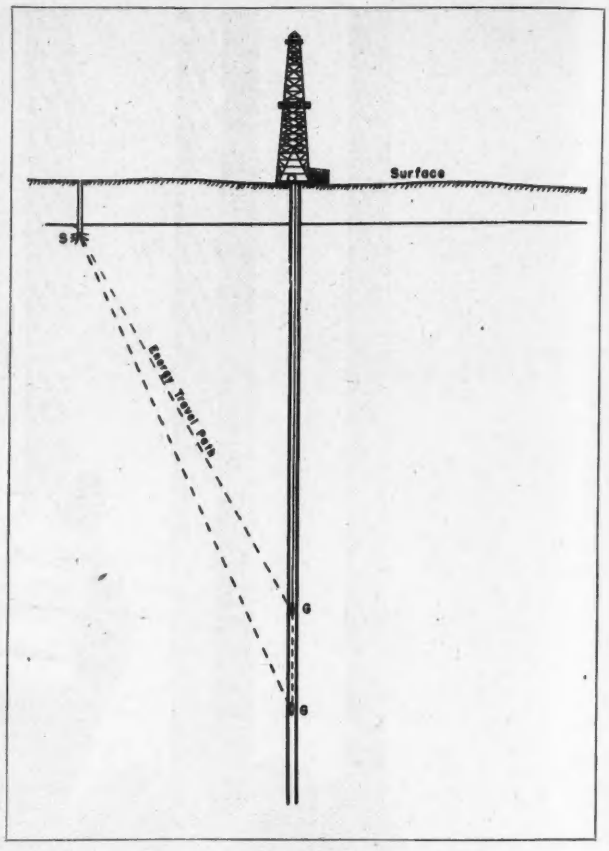

FIGURE 2

possible to calculate the depth or distance to any particular bed which produced the events on the seismograph records used. This is accomplished by using the simple formula

Distance = Velocity × Time.

Calculating Depth of Beds

By making certain assumptions, the principal one of which is that the subsurface beds are parallel to the surface, it is possible to calculate the depth to any bed using information obtained with regular surface seismograph equipment. Figure 1 shows that by using data from the surface geophone nearest the shotpoint (S) and from the geophone farthest from the shotpoint, two similar right angle triangles (SCA and SDB) or (ACE and BDF) may be set up. These two triangles have (using the above assumptions) two things in common. The depths to the bed AC and BD are equal, and the energy traveling from S to C and S to D, or C to E and D to F, travels through the same medium and therefore at the same velocity. The seismograph equipment measures the time that it takes the energy to travel these paths. The distances from S to A, E, B, and F are known from surface survey measurements. Knowing these factors two equations may be set up for the two similar right angle triangles and easily solved simultaneously for the depths AC and BD and for the velocity.

This calculation is correct only under limited conditions and with certain assumptions and is dependent to a very great extent upon the quality of the seismograph records of the energy returned to the surface at geophone No. 1 and No. 12. This calculation is impaired if the subsurface beds are not parallel to the surface. Any velocities calculated under conditions whereby the above conditions are assumed to exist, but do not, will be grossly incorrect. Structures which have been mapped from seismograph interpretation, using velocities thus in error, may be found to be non-existent, or larger, or smaller than indicated by the seismograph map, when drilled. Such errors usually are not the fault of the seismologist's ability, but are due to his lack of sufficient correct velocity information.

In order to overcome this velocity problem a technique has been developed whereby it is possible to measure the travel time of the energy from a shot near the surface to a geophone lowered to various depths in the well, and thus calculate the velocity. Figure 2 shows the schematic setup for such measurements. Some may raise the question that this is finding out the facts after the well is drilled. That is true, but finding the true velocity in this manner makes it possible to reinterpret the seismograph survey and possibly prevent the drilling of some dry holes. Such velocity measurements and information from every well drilled would give enough velocity control to seismologists that the drilling of many other dry holes could be avoided. Velocity information from every well drilled, however, would not be enough to prevent the misinterpretation of some seismograph surveys, for in some localities the velocity has been found to vary several hundred feet per second at positions within a few hundred yards of each other.

Use of Velocity Information

Velocity information obtained from time to time in a drilling well has been found to be quite useful. In one instance a seismograph interpretation based on velocity information obtained over 100 miles from the well predicted that the drill would encounter a certain formation at 7500 feet. Upon reaching that depth, the drill did not encounter the bed as predicted. A velocity survey at the well at that time showed a great enough difference in the velocity used in the original seismograph data interpretation and the velocity measured at the well that the bed in question was then predicted to be 2000 feet deeper. The drill encountered the bed as predicted using the new velocity. For some drill rigs this extra 2000 feet would have been quite a chore. Some contractors

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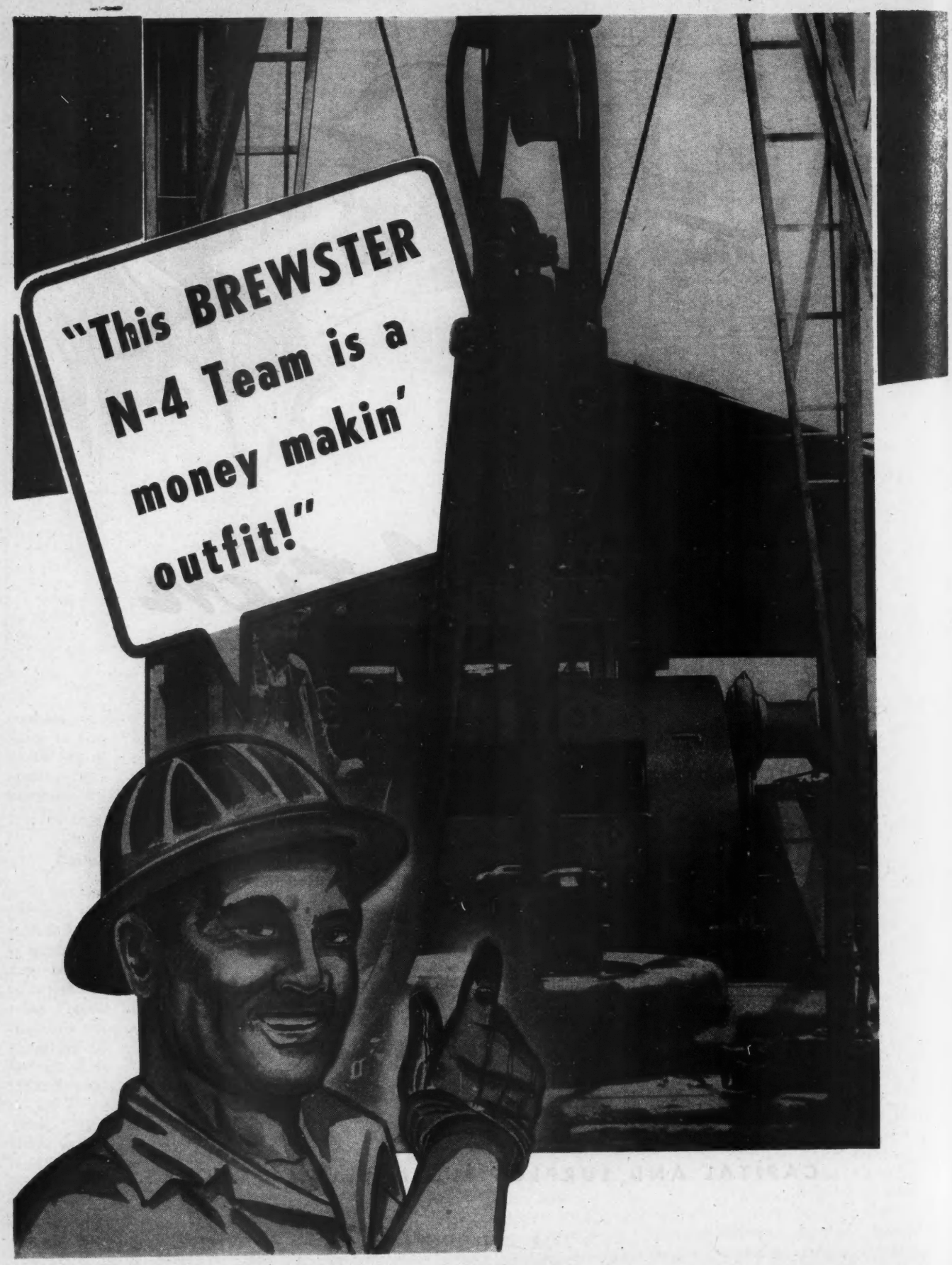

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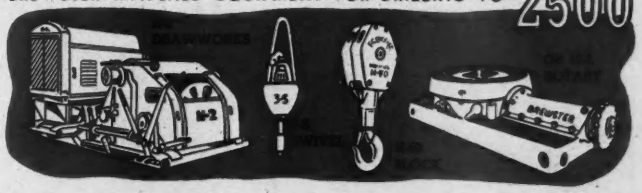

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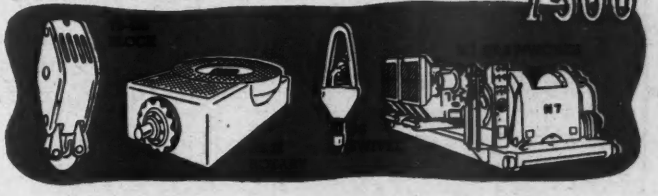

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might have lost considerable money in such a case.

We are quite often able to explain the technique involved in naming a velocity survey at an oil well by drawing a very similar parallel in terms and equipment familiar to most everyone. Suppose, for instance, that a contractor expects to make a contract to lay a large and expensive pipe line from Tulsa to Oklahoma City. Everyone living in the vicinity knows that it is 120 miles between the two cities, but our contractor is from some other locality and is not familiar with that fact, and his speedometer mileage counter is in error. He therefore decides to drive between the two places at a constant speed to see how far it is. He drives from Tulsa to Oklahoma City, Oklahoma, at exactly 50 miles per hour according to his speedometer, and it takes him exactly two hours to make the trip. His velocity thus was 50 miles per hour. With this data he calculates that it is 100 miles between the two cities, and takes the contract accordingly. However, when he lays the 100 miles of pipe that he ordered, he finds that it is 20 miles short of reaching between the two cities. A check on his speedometer (or velocity) showed it to be 10 miles slow when reading 50 miles per hour. With the corrected speed or velocity of 60 miles per hour, he is able to re-calculate, or re-interpret his data and find that it is 120 miles between the two cities and that he should have ordered that much pipe and made the contract accordingly. Also, when making another contract, he is able to use the correct speed or velocity to determine his distances and will be able to make the prices and order materials accordingly.

Velocity determinations at the wells are the "speedometer" corrections which confirm the seismologist's interpretation of seismograph work already done or compel him to re-interpret it. Such determinations or corrections also give him the correct information to use with future seismograph work to be done in the immediate vicinity.

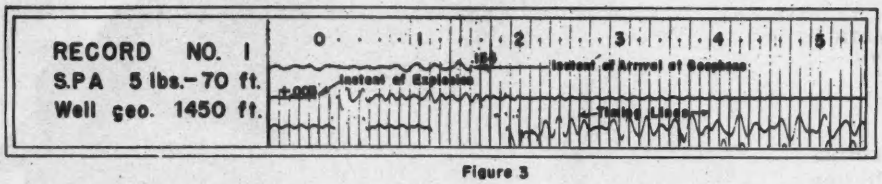
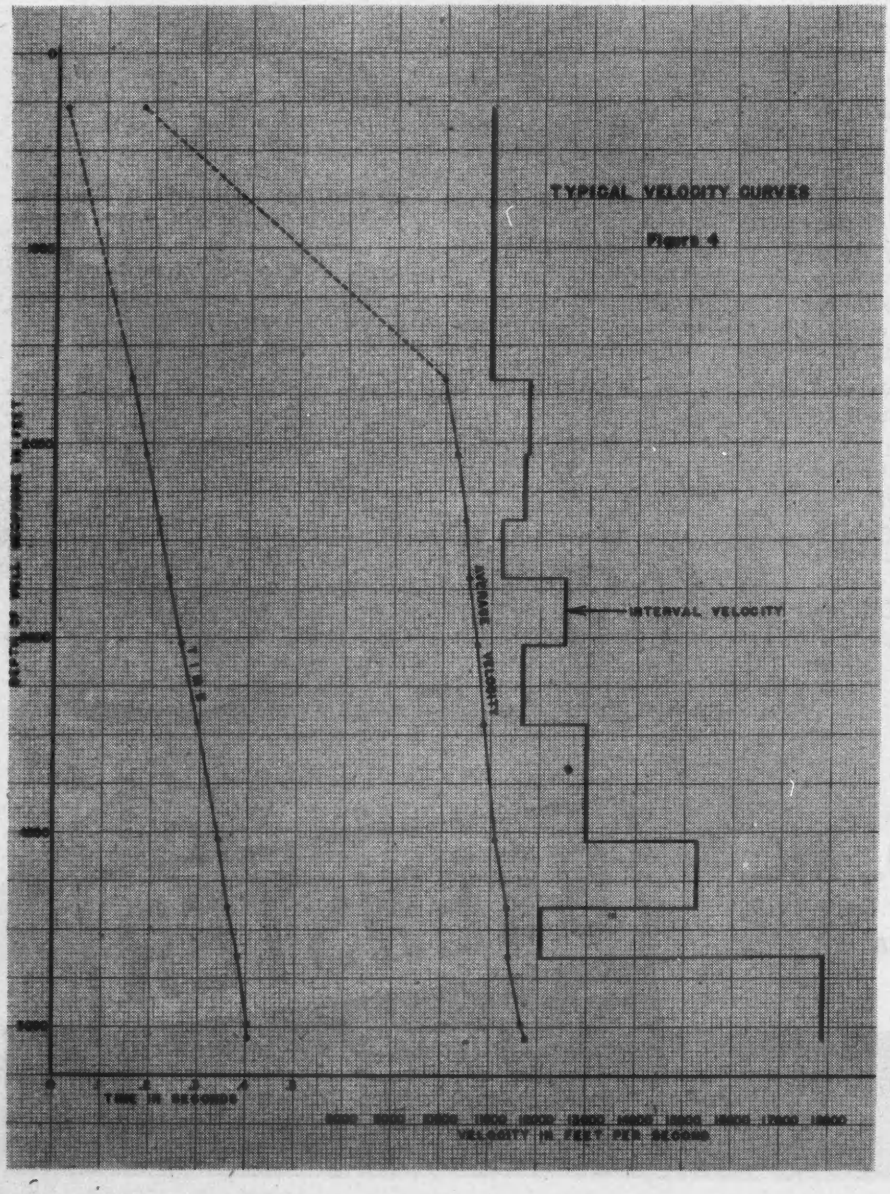


Figure 3



Determination of Velocity

The actual determination of velocity is simple. To determine how fast a horse can run, a stop watch is used and the run is timed over a known distance. His speed or velocity is determined in miles per hour or feet per second, or some such similar terms, from this data. A velocity determination made at a well is made the same way. As shown in Figure 2, a geophone built to withstand high pressure is lowered to various accurately measured depths in the well on an electric conducting line. At each depth of the geophone a charge of dynamite is exploded in a shallow hole near the earth's surface and at an accurately measured small distance from the well. The exact instant of the explosion is recorded on a strip of sensitized paper by an electrical impulse. The exact instant of the arrival of the first energy from the explosion at the geophone in the well is also recorded by a similar impulse on the same record. The time it takes the energy to travel between the two points is counted out by an accurately calibrated timing device which places a mark on the same record at intervals representing five or ten one-thousandths of a second. From all this data on the record and with the known distances between shot and geophone, the velocity of the travel of the energy is easily calculated. Figure 3 shows a typical record taken on one velocity survey. One of these records is taken for each position of the geophone in the well. The geophone is usually set at intervals of 500 feet between the bottom and top of the well.

Using the data taken from all these records, velocity curves are drawn up which show the average vertical velocity from the surface, to any depth, up to the depth of the well. From the same data, curves are drawn which show the velocity of travel of energy vertically between any two points of subsurface. Figure 4 shows a typical set of these curves.

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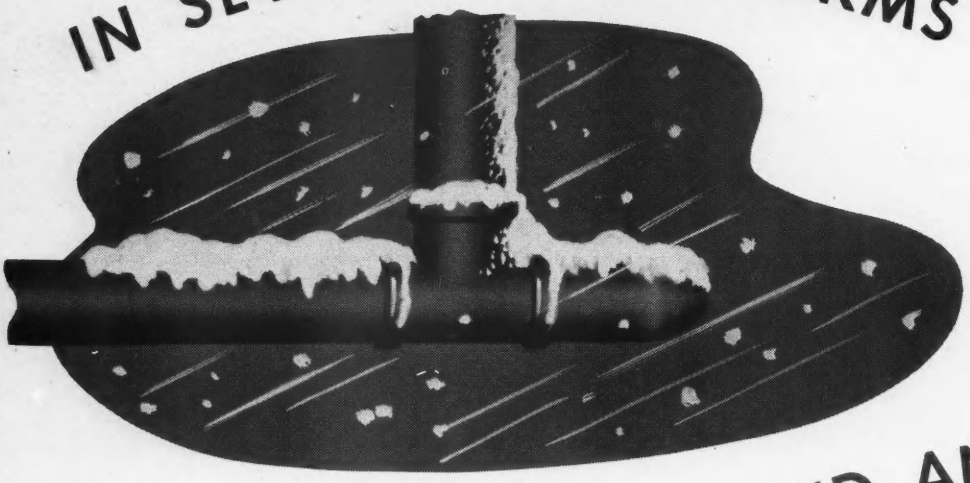

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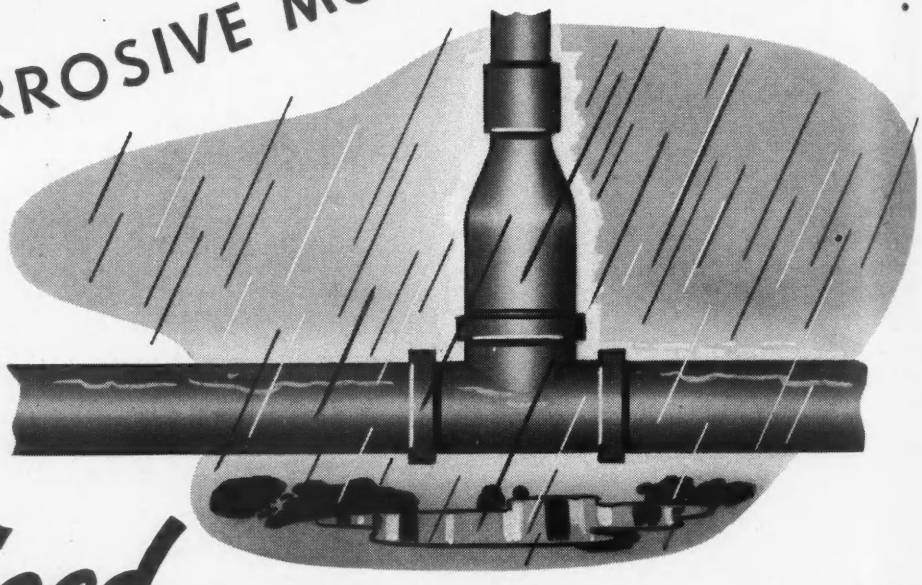

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Secondary Recovery

Adds to Arkansas Reserves

By L. L. JORDAN,
Petroleum Engineer

SECONDARY recovery methods applied to four flush producing oil pools in Arkansas during the past six years have increased rate of withdrawal and added in excess of 100 million barrels of recoverable oil, which is equivalent to the discovery of a new major oil pool.

These pools, Schuler-Jones sand, Haynesville Pettet lime (Arkansas portion), Midway limestone and Magnolia limestone, produce approximately 30,000 barrels of crude and 3000 barrels of other liquid hydrocarbons (natural gasoline, butane, etc.) per day, which is 40 percent of the daily production of the state.

Jones Sand Pool

The Jones sand pool, Schuler field, was discovered September 17, 1937, by the E. M. Jones Marine 1, completed at total depth of 7615 feet. By July 1, 1940, 146 producing wells on 20-acre drilling units had been completed. This pool had an initial bottom hole pressure of 3520 pounds per square inch at 7300 feet subsea and contained 762 cubic feet of gas in solution at the bubble point of 3520 pounds per square inch and 207° F.

During the development of the pool it was produced primarily as a solution gas-drive reservoir with practically no restriction for the first several months.

By January 1, 1941, the bottom hole pressure had declined to 1620 pounds per square inch and the gas-oil ratio had increased to 2440. With about 99 million barrels of oil in place the best estimate of recovery from the pool produced with solution gas-drive only was 35 million barrels.

Unitization of the pool and returning the gas to the reservoir seemed to be the solution to the problem. Unitization of 96 percent of the lease and royalty owners was accomplished and the Lion Oil Company elected unit operator, subject to a committee representing 12 owners in the pool.

Lion Oil began operating the unit February 15, 1941, under the supervision of the Arkansas Oil and Gas Commission. Closing in of high gas ratio wells helped conserve the reservoir energy until the plant could be built and the gas returned to the reservoir. (Return of gas began July, 1941.)

THE AUTHOR TRACES the effects of well-planned secondary recovery programs in four important areas, showing the methods followed in adding large volumes to anticipated recoveries and developing the spread of unitization or unit operation in each area.

With the gas injection program operating very effectively the operators decided to inject water into the reservoir to provide additional energy for the production of the oil. Water injection began June 2, 1944, and on November 1, 1947, a total of 1,785,236 barrels of water had been injected into the Jones Sand (929,257 barrels of salt water and 855,979 barrels of fresh water).

Production Periods—Jones Sand

PERIOD	Barrels Oil Produced	B.H.P. Decline psi	Recovery Bbls. Oil Per Lb. Drop
9-17-37 to 2-15-41..	16,731,615	1,911	8,755[1]
2-15-41 to 7-1-41...	1,437,325	72	19,962[2]
7-1-41 to 11-1-47...	24,174,241	105	230,231[3]

[1] Produced normally.
[2] Unit operation, natural energy only.
[3] Unit operation return of gas and water injection.

To April 1, 1948, a total of 43,717,506 barrels of crude oil had been produced and 1,477,181 barrels of other liquid hydrocarbons recovered by the gasoline plant operating in conjunction with the recycling plant as part of the unit operation of the pool.

Estimated ultimate recovery from the pool is 60 million barrels, of which 25 million can be credited to the secondary recovery methods of operation which have been made possible by unitization.

In the unitized operation, not all of the well bores are needed to produce the daily allowed oil so it has been profitable to perforate some of the upper lenses and 2¼ million barrels of oil have been produced from these small lenses that otherwise could not have been produced until such time as the Jones sand was depleted.

Haynesville Pettet Lime Pool

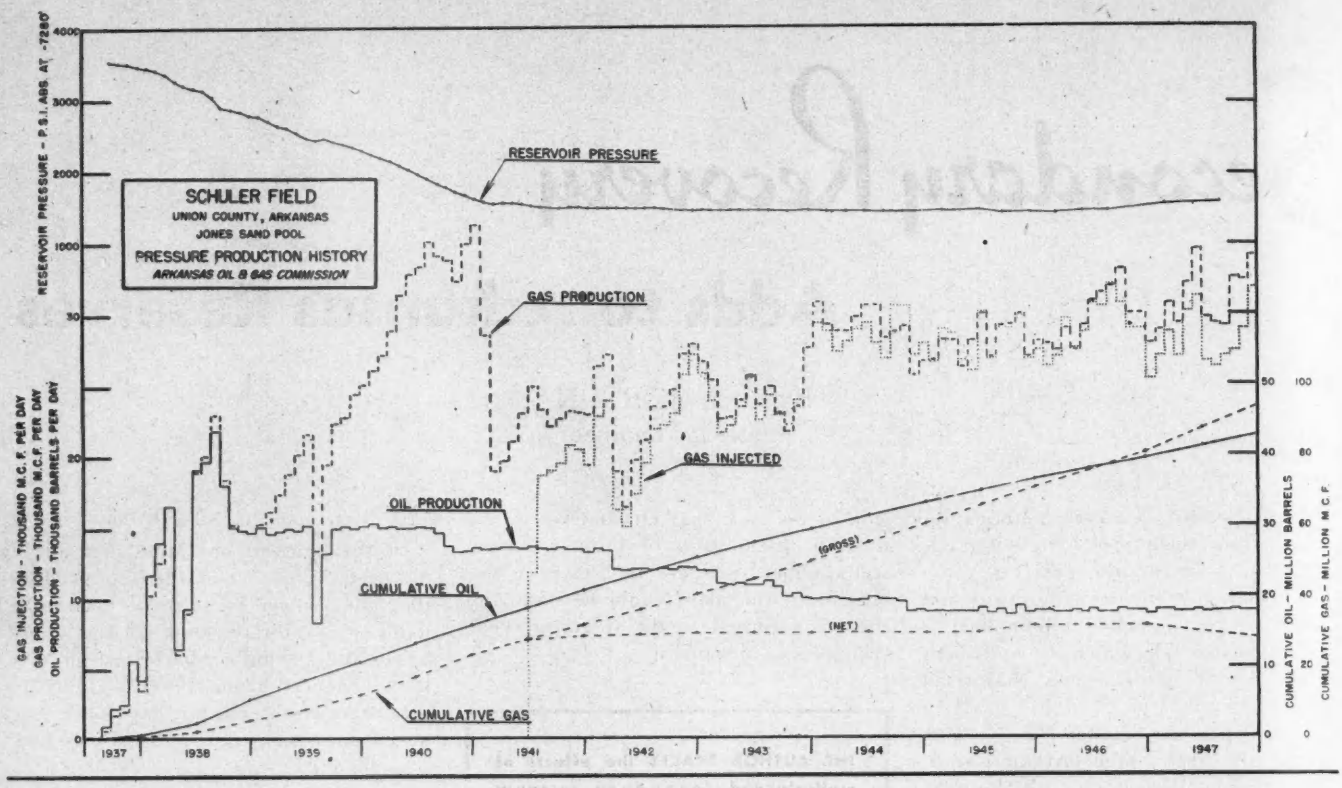
The Haynesville Pettet lime pool located in Claiborne Parish, La., and Columbia County, Ark., was discovered November 11, 1941, by the completion of T. L. James' Callie Aiken 1 and extended into Arkansas, December 15, 1942, by the completion of Navarro Oil Company's Beene 1, total depth 5540 feet.

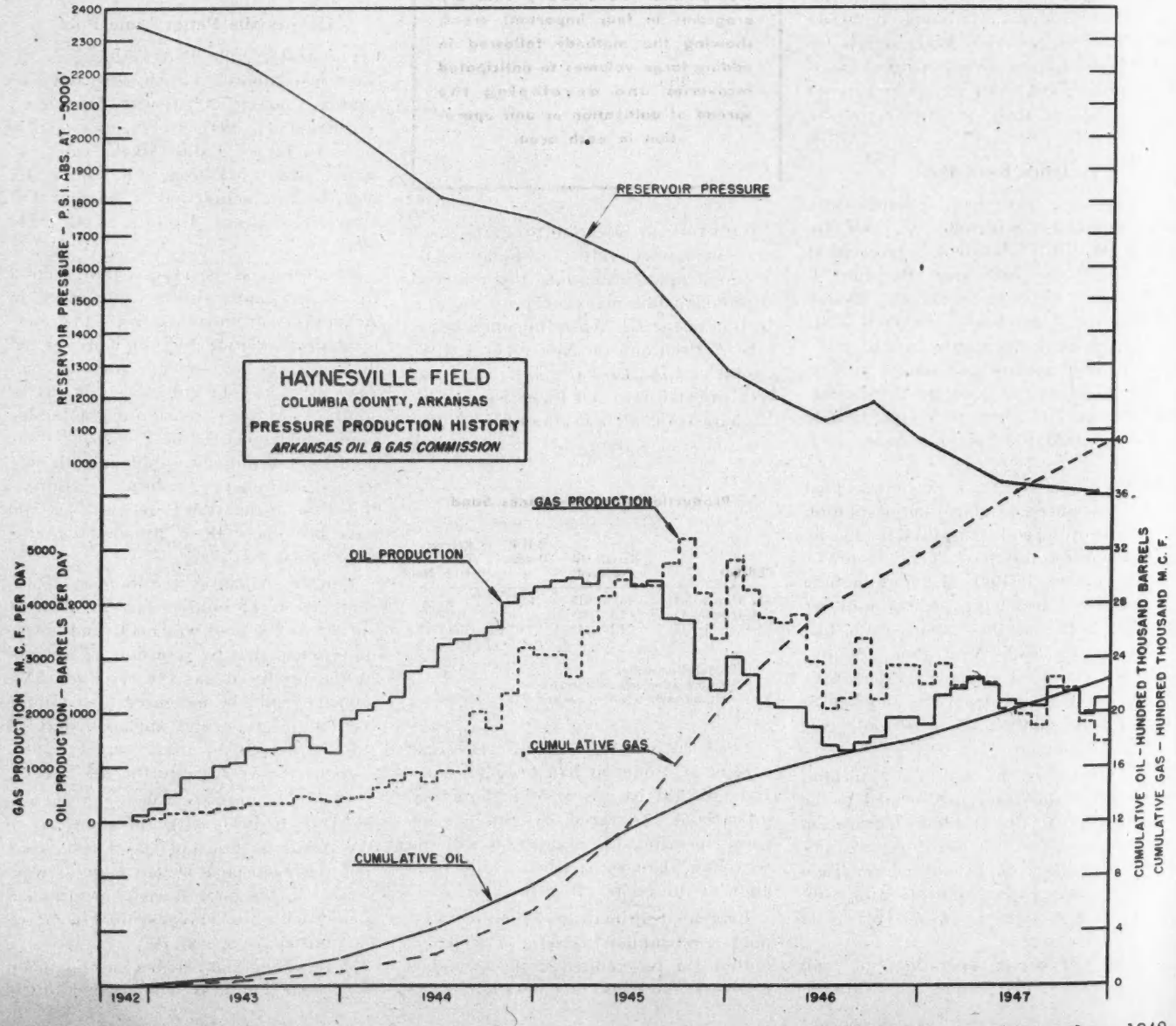
The reservoir is a very thin section (averaging approximately ten feet in Arkansas) of limestone with low permeability (average 13.5 millidarcys). At discovery the bottom hole pressure was 2440 psi with 514 cubic feet of gas in solution per barrel of oil and the bubble point determined to be 2346 psi. If the pool had continued to produce with only its natural energy, solution gas-drive, the best estimate of recovery would have been only 18 to 20 percent of the oil originally in place.

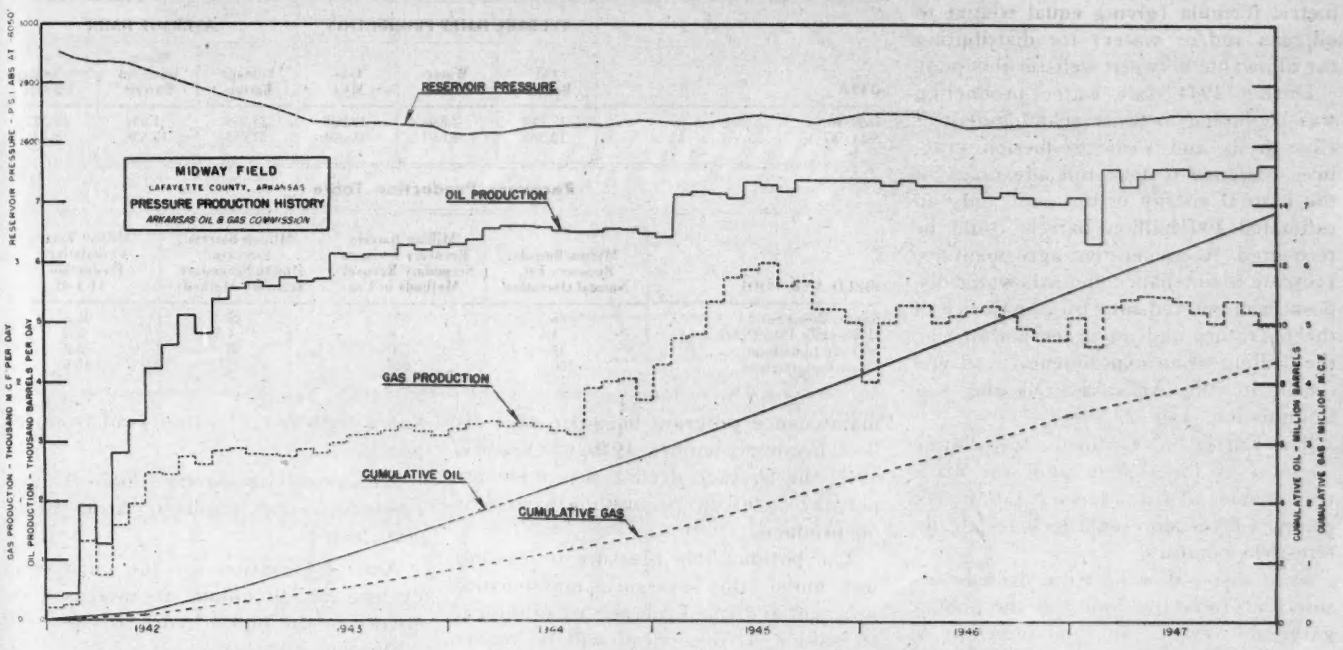
For the Arkansas portion this represents about 4.5 million barrels of oil. A survey of the pool was made and it was determined that by returning 80 percent of the produced gas the recovery (Arkansas) could be increased to 6 million barrels of crude and approximately ½ million barrels of other liquid hydrocarbons recovered from the gas.

Plans for unitization were started and on May 1, 1944, with the approval of the Arkansas Oil and Gas Commission and the Louisiana Department of Conservation, the pool started operation as a unit with the Haynesville Operators' Committee as operators.

A recycling plant with a gasoline plant in connection was constructed. Field


SCHULER FIELD
UNION COUNTY, ARKANSAS
JONES SAND POOL
PRESSURE PRODUCTION HISTORY
ARKANSAS OIL & GAS COMMISSION
RESERVOIR PRESSURE
GAS PRODUCTION
GAS INJECTED
OIL PRODUCTION
CUMULATIVE OIL
CUMULATIVE GAS
(GROSS)
(NET)
RESERVOIR PRESSURE - P.S.I. ABS AT -7280'
GAS INJECTION - THOUSAND M.C.F. PER DAY
GAS PRODUCTION - THOUSAND M.C.F. PER DAY
OIL PRODUCTION - THOUSAND BARRELS PER DAY
CUMULATIVE OIL - MILLION BARRELS
CUMULATIVE GAS - MILLION M.C.F.
1937
1938
1939
1940
1941
1942
1943
1944
1945
1946
1947


HAYNESVILLE FIELD
COLUMBIA COUNTY, ARKANSAS
PRESSURE PRODUCTION HISTORY
ARKANSAS OIL & GAS COMMISSION
RESERVOIR PRESSURE
GAS PRODUCTION
OIL PRODUCTION
CUMULATIVE GAS
CUMULATIVE OIL
RESERVOIR PRESSURE - P.S.I. ABS AT -5000'
GAS PRODUCTION - M.C.F. PER DAY
OIL PRODUCTION - BARRELS PER DAY
CUMULATIVE OIL - HUNDRED THOUSAND BARRELS
CUMULATIVE GAS - HUNDRED THOUSAND M.C.F.
1942
1943
1944
1945
1946
1947



tank batteries were removed and the well fluids separated at the well head and measured separately, then commingled and brought to the plant site in a single gathering system.

The Haynesville Operators' Committee decided it would be economical to supplement this recycled gas with a systematic water flood. In March, 1946, water flooding operations began; thus, a pressure maintenance program was begun by reinjecting gas supplemented by water flooding. (See API Paper—"Result of Experimental Water Flooding in the Haynesville Field, Pettet Zone, a Lime Reservoir Originally Under Dissolved Gas Drive," by P. S. Ervin, Haynesville Operators' Committee, prepared for spring meeting at Amarillo, Texas, May 22-23, 1947.)

By the addition of water-flooding to the recovery program already being carried out in the Haynesville pool, it is expected that the oil recovered will be double that which would have been recovered by solution gas-drive only. Thus, approximately 9 million barrels are expected from the Arkansas portion, of which 4.5 million can be credited to the secondary recovery methods employed in this pool.

To April 1, 1948, a total of 2,364,483 barrels of crude had been produced and 143,882 barrels of liquid hydrocarbons recovered from the Arkansas side of the project.

Midway Limestone Pool

The Midway limestone pool was discovered in Lafayette County, Arkansas, January 1, 1942, by Barnsdall Oil Company's Bond 1, completed at total depth of 6370 feet with an initial bottom hole pressure of 2920 psi at 6050 feet subsea. The crude was undersaturated with only 278 cubic feet of gas in solution and the bubble point was determined to be 2528 psi.

The bottom hole pressure fell very rapidly and it was soon seen that the natural water drive that existed in the pool was not sufficient to maintain an economical rate of withdrawal from the pool. Though the pool contained about 191 million barrels of oil at discovery it could recover only 35 million barrels of oil under production methods utilizing only natural energy. On April 19, 1943, Barnsdall began water injection on an experimental basis. Tests proved that this method of supplementing the natural energy should be successful.

A cooperative agreement for the injection of water into the reservoir was entered into in September, 1943, by all of the operators in the pool. Barnsdall was named the operator of the water injection program. This program proving successful, the estimate of recovery of oil from the pool has been raised to 70 million barrels, 35 million barrels more than would have been produced under normal operation methods.

On April 19, 1943, the bottom hole pressure of the pool at 6050 feet subsea was 2658 psi and on October 1, 1947, after 53 months of water injection and practically constant withdrawal rate, the bottom hole pressure was 2705 psi.

Due to the water injection program and the promised constant daily production of oil and gas from the pool, it was found feasible to build a modern gasoline plant which has been operating since August, 1944, on an intake volume of approximately 2½ million cubic feet of gas. This plant has recovered more than 417,000 barrels of liquid hydrocarbons, thus adding materially to the recovery from the pool.

Magnolia Reynolds Lime Pool

This pool was discovered March 3, 1938, by completion of Kerr-Lynn Oil Company's Barnett 1 in 14-17s-20w, Columbia County, Ark. The reservoir lies at approximately 7400 feet subsurface, covers about 4675 acres, and had in place 244 million barrels of oil at discovery with a bottom hole pressure of 3465 psi at 7100 feet subsea and a bottom hole temperature of 207° F. There was a gascap present in the reservoir at discovery and the oil contained 900 cubic feet of gas in solution at the bubble point of 3465 psi.

First under regulation of the Arkansas Board of Conservation and after March 1, 1939, under the Arkansas Oil and Gas Commission, the field was produced at rates designed to take advantage of the natural water-drive and maintain the original gas cap. Increasing water production from the pool caused the Arkansas Oil and Gas Commission to place in force August 1, 1943, a volu-

Comparative Production Data (Daily Figures)

DATE	PRODUCTION			INJECTION	
	Oil Bbls.	Gas MCF	Water Bbls.	Salt Water Barrels	Fresh Water Barrels
Oct. '43	6,273	1,652	254	254	4,341
Oct. '47	7,512	2,682	1,461	1,461	8,467
Cumulative to April 1, 1948: (Lighter Hydrocarbons 505,863 barrels)	14,453,162	4,582,000	1,721,812	13,635,443	

metric formula (giving equal weight to oil, gas and/or water) for distributing the allowable between wells in this pool.

During 1944, salt water production was beginning to cause abandonment of edge wells and with production practices designed to take full advantage of the natural energy in the pool, only an estimated 100 million barrels could be recovered. A cooperative agreement for pressure maintenance and salt water disposal was entered into by a majority of the operators and an order authorizing the drilling of an experimental well was issued by the Arkansas Oil and Gas Commission, July 27, 1944.

The Carter Oil Company was chosen operator of the system and was made responsible to an advisory committee composed of representatives of all interested operators.

Four disposal wells were drilled outside the productive limits of the pool, a gathering system laid, and injection of water into these four wells began January 31, 1945, October 10, 1945, February 24, 1946, and March 18, 1946.

Bottom hole pressure surveys indicated that the pressure decline had been halted and on November 1, 1946, the penalty on oil allowable for producing water was raised with the exception that a well's production of water should not exceed 12.5 barrels per acre per day.

The bottom hole pressure of the Magnolia Limestone Pool declined from discovery 0.188 psi per day or 13.1 psi per million barrels of oil produced until September, 1946, when the pressure maintenance program began to take effect. From September, 1946, to October, 1947, the average decline was 0.116 psi per day or 9.1 psi per million barrels of oil produced.

The bottom hole pressure is leveling out under this pressure maintenance program and it is expected an additional 40 million barrels of oil will be recovered, making a total recovery of 140 million barrels. To April 1, 1948, a total of 51,722,843 barrels of crude oil and 1,523,429 barrels of lighter hydrocarbons had been produced.

DATE	AVERAGE DAILY PRODUCTION			AVERAGE DAILY		
	Oil Barrels	Water Barrels	Gas MCF	Voidage Barrels	Water Injection Barrels	Net Voidage Barrels
Jan. '46	13,140	3,580	12,098	24,086	4,554	19,532
Sept. '47	12,260	6,650	13,094	27,964	12,858	15,106

Recovery Production Table

FIELD AND POOL	Million Barrels Recovery Est. Normal Operation	Million Barrels Recovery Estimate Secondary Recovery Methods in Use	Million Barrels Increase Due to Secondary Recovery Methods	Million Barrels Cumulative Production 11-1-47
Schuler-Jones Sand	35	60	25	42.3
Haynesville Pettet (Ark.)	4.5	9	4.5	2.2
Midway-Limestone	35	70	35	13.3
Magnolia-Limestone	100	140	40	49.8

Proposed Projects

Three other secondary recovery projects in flush pools are in the process of development at present.

Atlanta—Limestone Pool—Production from approximately 8000 feet, an experimental salt water disposal and pressure maintenance program.

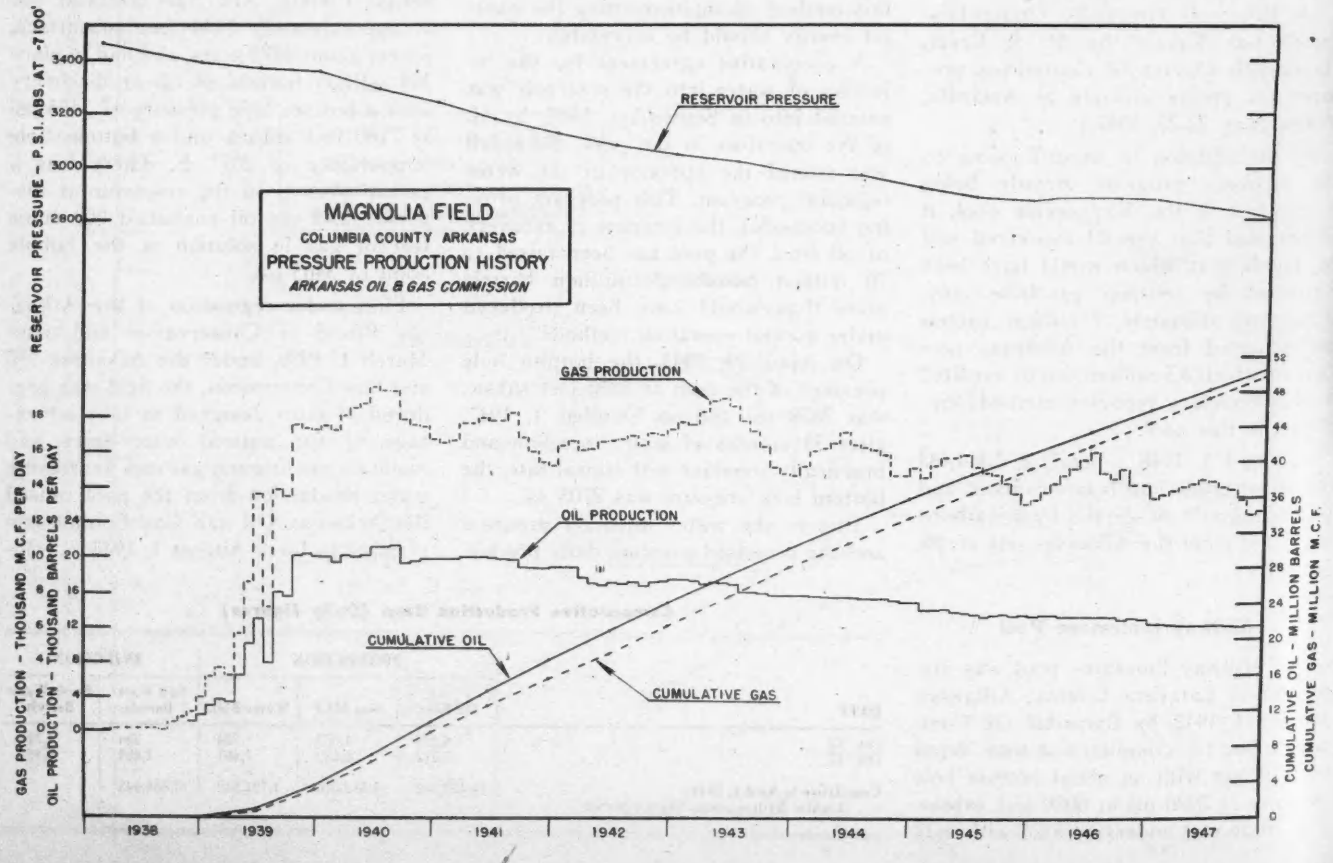
Aim: Cooperative program to maintain a high rate of withdrawal from the pool.

McKamie—Limestone Pool—A gas-condensate pool producing from below 9000 feet.

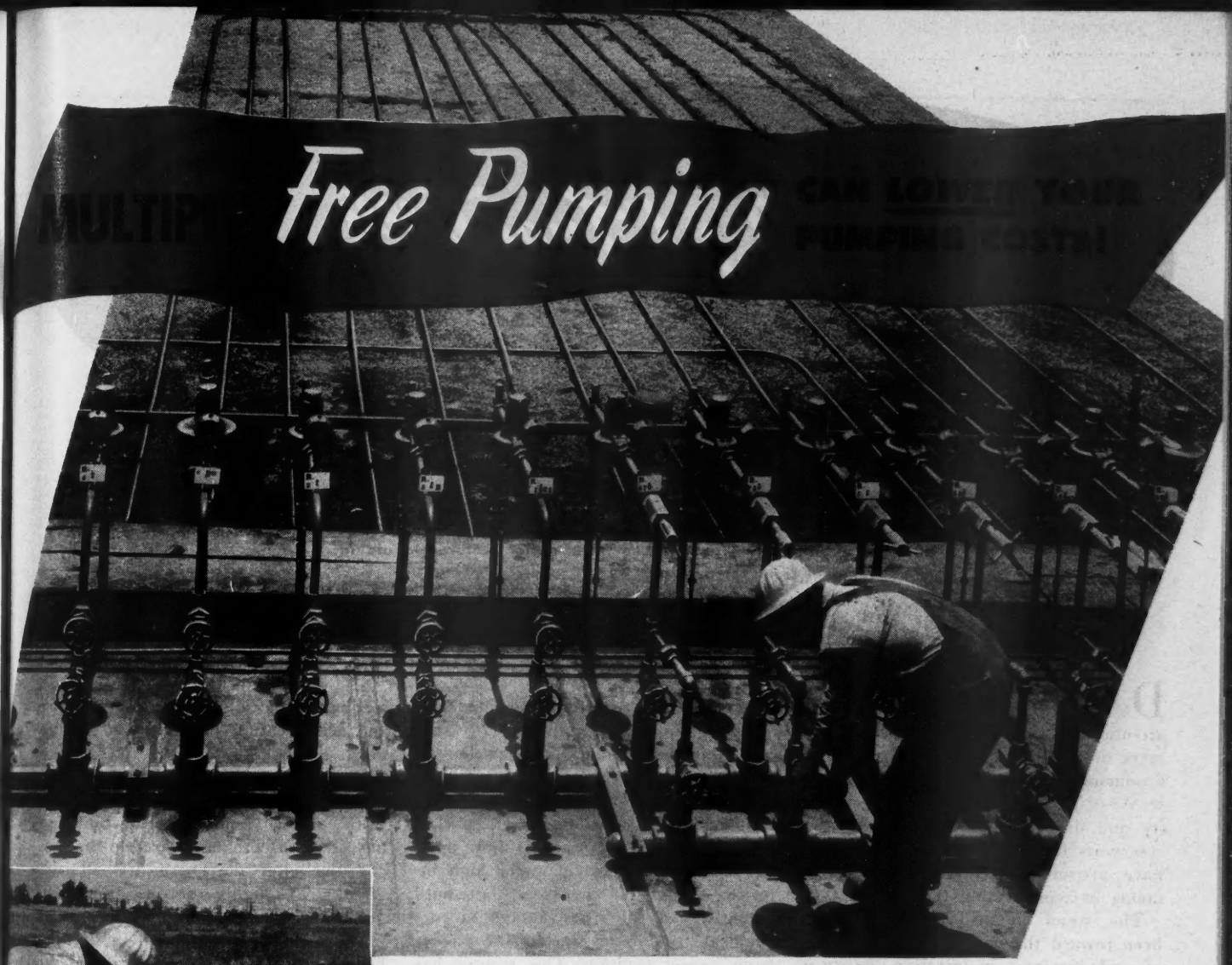
Aim: Unitization for the purpose of cycling gas to obtain an increased recovery of the liquid hydrocarbons.

Wesson Field—Hogg Sand.

Aim: Unitized pool for purpose of injecting gas or water into the reservoir. This sand pool lies approximately 3100 feet below the surface and contains some 1500 to 1600 barrels of oil per acre foot in place. Its natural energy is considered solution gas-drive, no evidence of a water drive having been found. The bubble point has been determined to be in the neighborhood of 360 psi. The reservoir pressure November 1, 1947, was 608 psi and an estimated recovery under natural recovery mechanism is only 350-70 barrels per acre foot.



Free Pumping



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THESE ARE THE DAYS OF FREE PUMPING

Acid Treating Technique

AN IMPROVED technique for acidizing wells completed from thick zones of dolomite is described. This method makes use of a recently developed packer with special features to aid in removal from set position.

By JOE H. MOORE *and* JOHN W. ADAMS

DURING the past several years much attention has been given to acid treatment of wells completed from dolomite producing zones in the Permian Basin of West Texas. Increased drilling activity and discovery of sizable sweet oil reservoirs from deeper Permian drilling have provided incentive for improvements in acid treating technique.

The trend in acid treatments has been toward the use of larger amounts of acid, increases in injection pressures and rates, and treatment of thick producing zones by short intervals.

The main objective in acid treating wells producing from dolomite or limestone reservoirs is to increase the permeability around the bore hole and thereby decrease the resistance to flow of oil into the well. The nature of porosity and permeability in these types of reservoirs is erratic and measurements of these properties in core samples generally show alternating high and very low indications of porosity and permeability.

Because of this wide variance of permeability, one important consideration in acid treatment is to inject most of the acid into the less permeable streaks where the need is greatest. This can be done best by acid treating short intervals of similar permeabilities.

In acid treatments wherein intervals of both high and low permeabilities are subjected to acid injection simultaneously, most of the acid goes into the more permeable streaks, and little or no benefit from the acid is gained in the less permeable streaks.

To accomplish the most efficient use of acid by selectively treating short intervals, two methods have been in general use. One method uses the two-pump procedure of controlling the placement and injection of the acid. A second method makes use of a packer or packers to control the acid placement and injection. Both methods have advantages and disadvantages. The packer method has the advantage of more positive control of the acid under high injection rates and pressures, but until recently had the disadvantage of mechanical trouble in freeing the packer from its set position. This trouble has been eliminated by the development of a packer with special features offsetting this difficulty.

Packer Method of Acid Treating

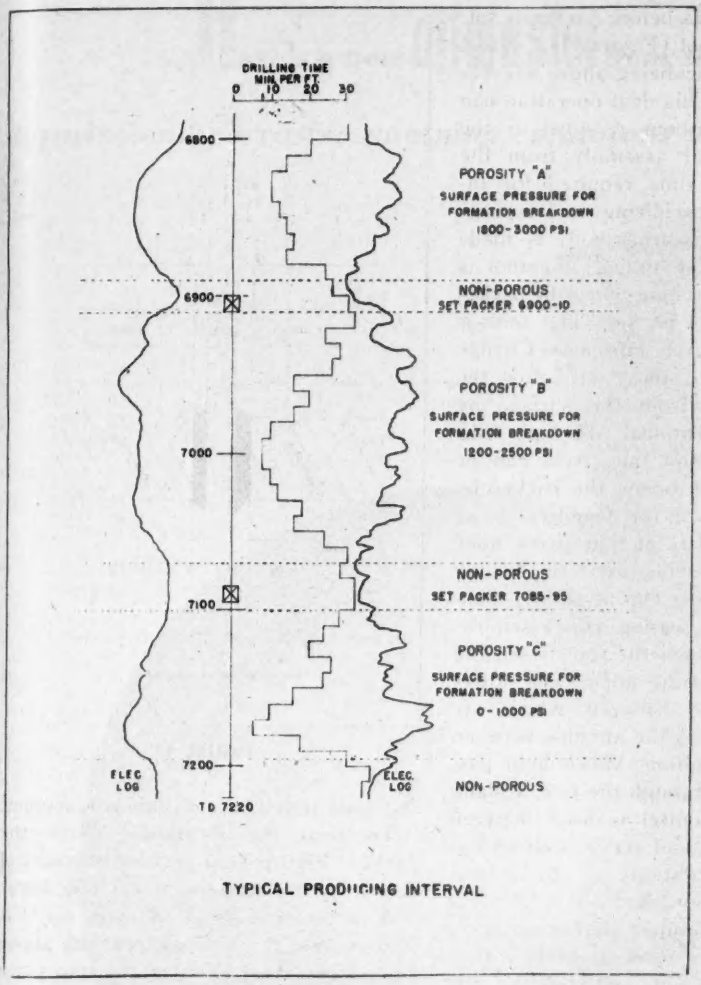
This paper describes the development of an improved acid treating technique using the newly developed packer and auxiliary equipment as applied to wells completed from the lower Permian, Clearfork producing zone in the Fullerton field, Andrews County, Texas. Because of the great thickness of the oil-producing reservoir, there was an urgent need for acidizing by short intervals in this field.

The Fullerton field is in the north central portion of the Permian Basin of West Texas. The field is approximately 15 miles northwest of the town of Andrews, Texas, and 25 miles southeast of Hobbs, N. M. The field was discovered in March, 1942, by Fullerton Oil Company. To date more than 465 wells have been completed from the Clearfork series at depths from 6800 to 7200 feet. Most completions were made by setting casing above the producing zone. The producing interval was then drilled with low water-loss mud or with oil and treated with acid. About 10 percent of the wells was completed by setting casing into the producing zone and acid treating through gun perforations.

The producing zone is in crystalline dolomite from 200 to 350 feet thick. Both porosity and permeability as measured in cores are variable throughout the interval. There are alternate streaks of highly porous, permeable dolomite and dense dolomite. A typical producing section is shown in Figure 1 by the electric log and drilling rate curves. Also shown are the individual surface pump pressure ranges required to break down the formation before acid injection into the different intervals of the productive zone.

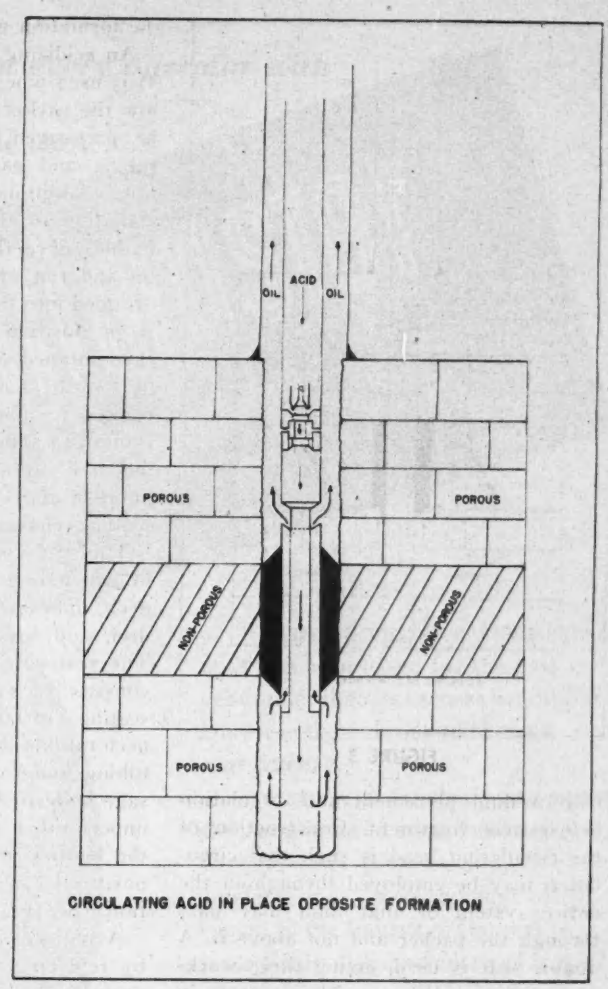
It was seen early in the development of the field that an effective acid treatment could not be made by treating the entire zone in one stage. When treated in this manner, most of the acid would follow the path of least resistance and go into the most permeable streaks. The less permeable streaks would not be affected by the acid. In order to obtain an even distribution of acid throughout the entire producing zone, it would be necessary to acidize by short intervals, treating the intervals of different permeabilities separately.

At the completion of the first wells in the field, attempts were made to acidize separately the three intervals of different break-down pressures as shown on Figure 1. Usually the upper interval of approximately 100 feet was drilled and acidized with a packer set in the casing just above the shoe. A second interval of about 200 feet was drilled and acidized with a packer set in the dense interval between the two porous streaks. The bottom interval was drilled and acidized in a like manner. The



TYPICAL PRODUCING INTERVAL

FIGURE 1



CIRCULATING ACID IN PLACE OPPOSITE FORMATION

FIGURE 2

packers used were conventional anchor-type packers, run on two-inch tubing.

Much trouble was encountered in freeing the packers after setting in the open hole. Several times the two-inch tubing was parted in attempts to pull the packer. In later packer settings, 2½-inch tubing was used instead of the two-inch size, and the problem of parted tubing was to some extent eliminated; however, four to eight hours were generally used to work the packers free from the formation. To overcome this difficulty, experimentation was made with several features to aid in freeing the packer. As a result of this work, a type of packer with telescoping mandrel and pump-out device was developed.

To aid in freeing the packer when ready to be pulled from the set position, the packer body was made with an outer mandrel against the packing element and with a smaller mandrel inside. This packer is set in the same manner as a conventional anchor-type packer. When the packer is pulled, the outer mandrel is raised above the rubber packing element before upward pull is exerted on the packing and lower parts of the packer assembly. The removal of the large outer mandrel from the tightly compressed packing element allows space for the packing to contract and thereby become free from bore hole.

Component parts of this type of packer are shown in Figures 5 and 6. Figure 5 shows the packer in set position and Figure 6 shows the telescoping feature when the outer mandrel is pulled out of the packing element in unseating the packer.

This aid in unseating packers proved quite successful in operation, and it was possible to run packers without fear of having trouble in getting them unseated. It was now possible to use longer packing elements than had been used previously. In order to obtain greater surface area for positive shutoff in open formation, a 51-inch oil and gas resistant rubber packing was used on the telescoping type packer. It was found that this longer packing element provided excellent shutoff and held when pressures up to 3500 pounds were required to obtain formation breakdown before acid injection.

Hydraulic Feature to Aid in Unseating Packer

An additional feature was designed to be used with the telescoping type packer. This feature makes use of pump pressure applied between packer mandrels to force them apart in unseating. This aid is especially needed for use in deeper wells where the weight of the tubing is near the tensile strength and only a very small amount of pull can be exerted to unseat the packer.

Reference to Figures 5 and 6 will facilitate understanding of this packer feature. Parts of the packer are labelled in both figures, showing their relative positions when the packer is in set position (Figure 5) and freed from the formation (Figure 6). No attempt has been made to show mechanical detail as such in the illustrations.

Procedure for use of the hydraulic feature to aid in unseating the packer is described as follows:

The pumpout plug (A) is dropped into the tubing and seats in the inner mandrel (B) of the packer. This plug shuts off fluid passage to the formation below the packer. Pump pressure may then be built up inside the packer. This hydraulic pressure forces the outer mandrel (C) out of the packing element and allows the rubber (D) to contract on the exposed smaller inner mandrel (B), freeing the packer from its set position.

The circulating head is a feature added to the packer to give better con-

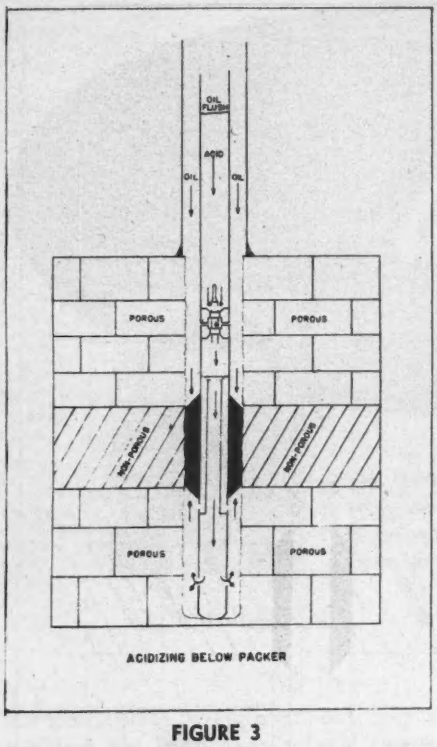


FIGURE 3

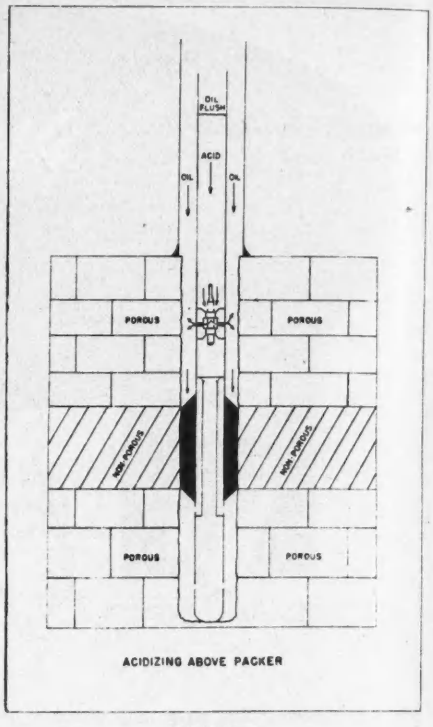


FIGURE 4

trol of fluid placement and circulation before acid treatment. Construction of the circulating head is such that circulation may be employed throughout the entire system or that fluid may pass through the packer and not above it. A double seat is used, giving three working positions. When neither seat is in place, the tubing is held three or four inches off the upper seat and circulation through the system is achieved (Figure 2).

The upper seat in place with partial weight of tubing imposed allows fluid to pass only through the packer and into the formation. This position is used when acidizing the porous formation below the packer (Figure 3).

The third position, lower seat in place, is used when pulling the packer. This shutoff is necessary so that the system can be entirely closed and hydraulic pressure applied in unseating the packer.

Advantages of the circulating head are as follows:

1. The packer can be set and tested for shutoff before acid is spotted on the formation. This eliminates the necessity of reversing acid out of the hole when a packer seat is not obtained.

2. When the packer is set and tested, acid may be circulated to position opposite the formation before acid injection pressure is applied. This eliminates squeezing the tubing load of fluid into the formation ahead of acid.

3. Circulation can be achieved through the packer assembly when going into the hole or spotting acid on the formation with little fluid passing between the packing element and the formation walls. This prevents frequent cutting of the formation walls before packer is set.

An acidizing tool (Figures 1, 2, 3 and 4) is used when acidizing above and below the packer. This dual operation can be performed without removal of the tubing and packer assembly from the hole. Additional time required for installation of the acidizing tool is negligible, since the seating body is made up and run on the tubing; the tool is dropped into the tubing when the packer is in position to be set. The tool is then pumped securely into place. Change of tool to acidize above or below the packer is made from the surface by running a conventional slip-type fishing tool on a sand line. Acid can be pumped above or below the packer by making changes of the mandrel.

The tool consists of four parts, none of which is a moving part; the fishing neck, upper seating cup assembly, mandrel, and lower seating cup assembly. The seat into which the tool is secured consists of identical upper and lower seating surfaces, between which are perforations out to the annulus between tubing and formation. When fluid passage is desired through the tool, a blank unperforated mandrel is used between the seating cups and set in position opposite the perforations to the formation. (See Figures 2 and 3.)

Acid may be pumped above the packer by replacing the blank mandrel with a perforated one and bull-plugging the bottom of the tool. Thic change forces the acid through the tool perforation and out into the formation. (Figure 4.)

Procedure in Acid Treating

The steps followed in treating a well by intervals with one packer setting are shown in Figures 2, 3, and 4. The packer is run into the hole opposite the dense streak selected for the packer seat. The packer is set and tested for shutoff, after which the circulating head is opened. Acid is then circulated into place by displacing the fluid in the tubing through the system and out the circulating head at the top of the packer (Figure 2). A blank mandrel is in place in the acidizing tool, the circulating head is closed (Figure 3), and pump pressure is applied at the surface to force the acid into the formation below the packer. Surface pressure is applied on the casing side to lessen the differential pressure across the packer. After injection, the spent acid is swabbed out and the zone tested in conventional manner.

To treat the formation above the packer (Figure 4), a perforated mandrel is run in the acidizing tool. The lower end of the mandrel is plugged so that flow is only through perforations above the packer. Acid is circulated into place opposite the formation and injected by applying pump pressure to the tubing. Pressure is held on the casing by a closed valve on the casing head. The blank mandrel is replaced in the acidizing tool preparatory to applying pump pressure to aid in unseating the packer at completion of the treatment and testing.

The results of testing the wells natural and after acid treatment showed that in nearly all cases the use of acid greatly improved the flow rates from the producing intervals. It is estimated that one-fifth of the wells in the field could not have been completed as flowing wells without the use of acid. The following tabulation shows tests before and after acid treatment for the three intervals. Figures are given for typical wells in the most prolific sector of the field (A) and wells in the areas of lower permeabilities (B).

The best comparison between results from acidizing by short intervals and

Interval	Test Before Acid	Test After Acid	Gallons of Acid Used	Number of Stages
Upper	A Flo. 10 BOPH	Flo. 30 BOPH	6,000	1
	B Swabbed 5 BOPH	Flo. 20 BOPH	8,000	2
Middle	A Flo. 30 BOPH	Flo. 70 BOPH	8,000	1
	B Swabbed 10 BOPH	Flo. 35 BOPH	10,000	2
Lower	A Flo. 30 BOPH	Flo. 45 BOPH	4,000	1
	B Swabbed dry	Flo. 10 BOPH	4,000	2

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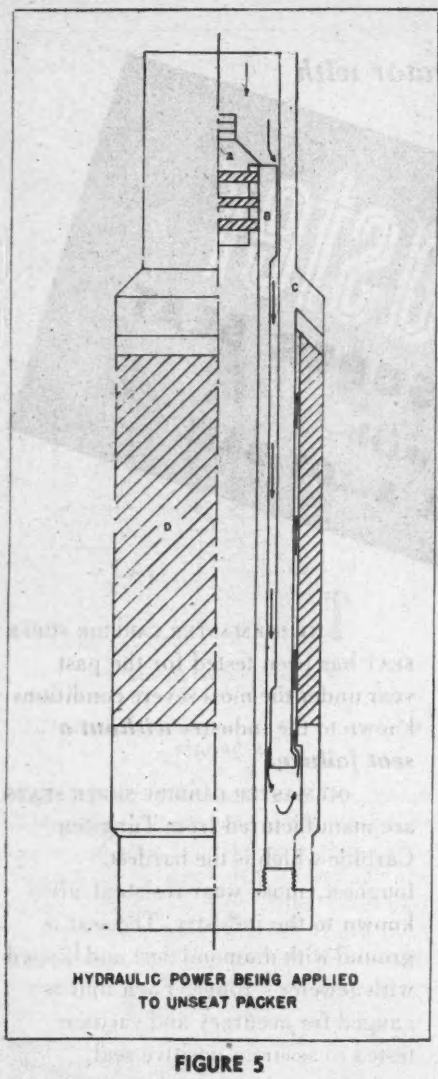


HYDRAULIC POWER BEING APPLIED TO UNSEAT PACKER

FIGURE 5

treating the entire zone in one stage can be seen in the wells which have been retreated by intervals after previously having been treated as one interval. The flow rates from several wells treated in this manner were doubled or tripled over the rates obtained in the original single state treatments. In some cases the gas oil ratios were lowered by entry of additional oil into the wells.

The original cost of acid treating by short intervals is greater than the cost of acidizing the entire producing zone in one stage; however, the advantages gained by obtaining an effective acid breakdown throughout the entire zone compensates for the additional cost. If the use of acid for a well completion is economically feasible, it is good practice to apply the acid in such a manner as to obtain the maximum benefit from its use. There are many completions in dolomite producing fields where a commercial well would not have been obtained without the use of acid. In most of these cases, the use of short-interval acidizing would improve the flowing characteristics of the wells.

Defining these short intervals must be done in a manner such that operating cost is not excessive. Portions of the formation with comparable porosity and permeability are segregated, being separated by a non-porous portion suitable for setting a packer. Sacrifice of efficiency is sometimes made in order that too many portions are not chosen, but in general, the portions fall in a range of break-down pressures which is not so wide.

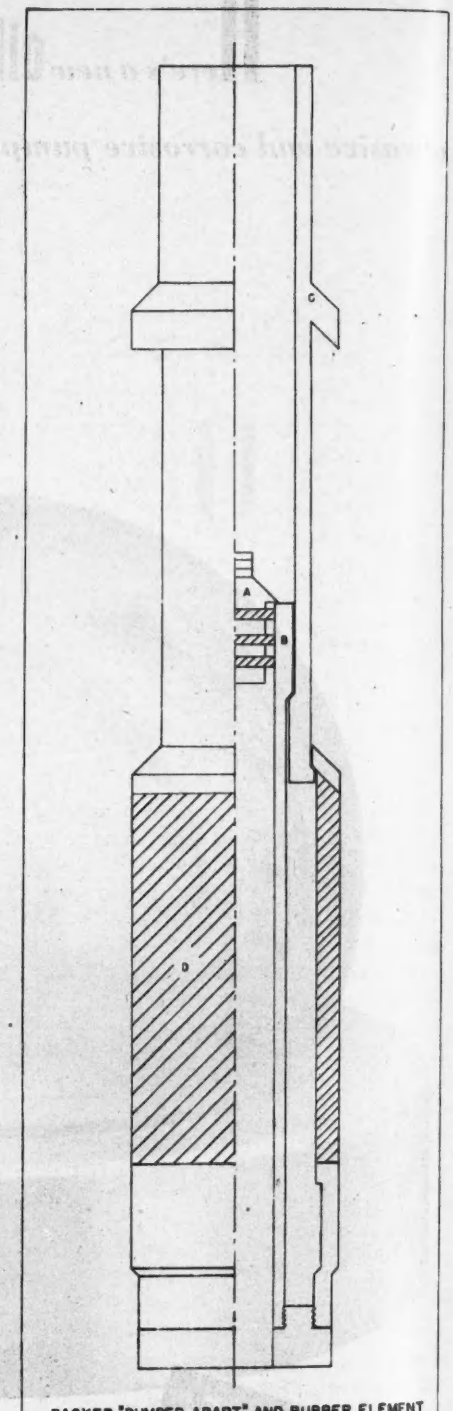
Improvement of the flowing characteristics is the major factor in offsetting increased acid treating costs. It has been found that installation of pumping or artificial lift devices will be postponed when the producing zone is properly treated at completion. This prolongs the "low lifting cost" period of the well. Former practice of large acid treatments of one stage at periods of declining well performance has necessitated additional cost involving workover equipment and crews. This item alone, plus disadvantages in workover procedure stemming from a partially depleted well, presents a strong case for short-interval acid treating on original well completion.

Other Applications

Use may be made of the telescoping type packer either in cased or open hole; however, the original design intended use primarily in the open hole.

Two of these packers may be run to test a zone between them. This is desirable either for acid treating or for production tests in locating water or gas zones. Some dolomite formations in the Permian Basin are encountered where only very small oil shows are obtained. Frequently these shows are passed in drilling to an originally projected greater depth. When attempting to test this upper show at a later date, the mechanical solution has been either to plug back to a point at the base of the oil show and drill stem test or to set casing and test. The telescoping type packer run dually—one packer element above and one below the show—has been found successful in isolating these zones for testing and acid treating. This procedure has eliminated the large financial risk involved when running casing on the basis of an oil show which did not originally appear to warrant the expenditure.

The packer has also been used recently in exploratory drilling as a combination testing and acid treating tool. At greater depths where round trips with tubing and drill pipe are more expensive, the packer may be left in set position and used for acidizing and subsequent production tests. This procedure eliminates expense of rig time necessary in pulling a testing tool and running a packer with which to acidize.



PACKER "PUMPED APART" AND RUBBER ELEMENT FREE FROM SEAT IN FORMATION

FIGURE 6

ACKNOWLEDGMENTS

Since the theory of short-interval acidizing has been shared by many, major acknowledgments are made to those men who have contributed to the development of the mechanical methods necessary to this technique. Original design of the telescoping type packer and auxiliary equipment was made by C. H. Sweet. J. B. Davis, Clyde Waugaman and Fred Warren, under whose supervision the packers were run and the acidizing done in the field, contributed much to the development of the equipment and to the acidizing technique. All of the above mentioned are in the employ of the Fullerton Oil Company, Hobbs, N. M. Acid treating procedure was evolved through close cooperation between these men and the field personnel of the Western Company, Seagraves, Texas. Contributing much to both mechanical and acid treating technique was D. M. McCoy, formerly of the Western Company, now with the Sweet Oil Well Equipment Company, Hobbs, N. M.

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Squeeze Cementing

FACTORS WHICH INFLUENCE OR DETERMINE THE EFFECTIVENESS OF SQUEEZE CEMENTING ARE DISCUSSED BY THE AUTHOR, WHO RECOMMENDS THOROUGH TESTING OF EQUIPMENT PRIOR TO ACTUAL PUMPING. FORMULAE FOR DETERMINING DOWN-THE-HOLE PRESSURES ARE SUGGESTED, AS WELL AS PRECAUTIONS REGARDING CHOICE OF CEMENT AND MAINTENANCE OF FLOW DURING OPERATION.

By W. E. BEST

SQUEEZE cementing is a term applied to any type of cementing job wherein pressure is applied in such a way as to cause cement slurry to be driven either into the formations surrounding the well bore, or through perforations behind the casing.

The more important purposes of squeeze cementing are as follows: to repair casing leaks resulting from split casing, collapsed casing, or from corrosion; to repair poor or unsuccessful casing cementing jobs; to plug gun perforations in casing; to reduce high gas-oil ratios; to shut off water; to cement liners in place; and to place additional cement behind casing where insufficient cement was used earlier, in order to test upper pay zones.

Type of Cement Used

The type of cement to be used in a "squeeze" is determined by the bottom-hole temperature which increases with depth. Bottom-hole temperatures have been recorded from 90° F. in 3000-foot wells in Central Oklahoma, to above 300° F. in wells on the Louisiana Gulf Coast. The high temperatures accelerate the setting time of the cement and shorten the time in which a cement slurry will remain pumpable before the initial set takes place. For bottom-hole temperatures up to approximately 140° F., manufacturers believe regular Portland cement can be used successfully. However, for bottom-hole temperatures higher than 140° F., the cement manufacturers recommend slow-setting cement.

Figure 1, taken from the "Oil Well Cementing Guide," published by the Universal Atlas Cement Company, shows the effect of temperature on the period of pumpability.

The period of pumpability of a cement slurry is very important in squeeze cementing, as some jobs, especially the deep ones, require considerable time for displacement of the cement, and as pump pressure increases the rate of displacement becomes slower, extending the displacement time. Therefore the bottom-hole temperature, the depth of the job, the purpose of the squeeze job, and the anticipated displacement time for the slurry should be considered in choosing a type of cement for a squeeze job. The hazard of premature initial set can be minimized and thus avoid sticking the squeeze tool, tubing, or drill pipe in the hole.

Regular Portland cement is being used quite successfully in squeeze jobs in wells below 5000 feet with bottom-hole temperatures ranging up to 170° F., because the displacement time of the cement is short.

About the Author

W. E. BEST is a native of Gas City, Ind., and went to work in the oil fields in 1926 as field clerk in Wilbarger County, Texas, for Phillips Petroleum Company. Later he transferred to production and worked as roustabout, roughneck, pumper, and tool dresser. In 1940 he received a B. S. degree in petroleum engineering from the University of Oklahoma and since then has held positions as engineer, assistant production superintendent and tool pusher. He is presently with The Ohio Oil Company as district petroleum engineer at Pauls Valley, Okla.

An example of what can happen when the wrong type of cement is used, occurred in western Garvin County, Oklahoma. The operator was attempting to cement a liner at 10,000 feet, using 400 sacks of regular Portland cement. Before the cement was completely pumped down, the slurry took initial set, and approximately 1000 feet of tubing was cemented in the hole.

The type of slurry used in squeeze cementing is of great importance. Cement manufacturers recommend that only enough water be used to make a slurry which is easily pumpable, since the object of the squeeze job is to force cement particles into the voids and channels of the formation. The addition of water will not change particle size and the excess water will produce a cement of low strength and high permeability. A slurry weight between 15 to 16 pounds per gallon is recommended, and a slurry of less than 15 pounds per gallon may result in failure. The slurry should be uniform in weight, and can be controlled during mixing by frequent checks with mud scales at the mixing tub.

Pressures Used in Squeeze Cementing

The maximum permissible surface pressure used in squeeze cementing is controlled by several factors; condition of casing in the well and other well equipment; the depth of the squeeze job; the kind of job, shutting off the water; reduction of high gas-oil ratio; repair of casing leak; repair of a poor cement job; and plugging off the gun perforations.

There has been suggested a formula[1] for determining maximum surface pressure. "Pressure to be applied equals 40 percent of the depth of the horizon plus 1000 pounds per square inch." Another formula, as suggested by waterflood engineers for maximum bottom-hole pressure before disturbing the overburden in squeezing follows: "Bot-

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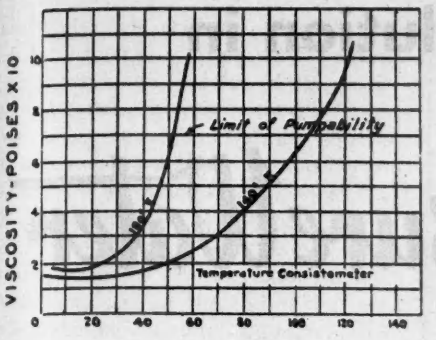

FIGURE 1. Effect of temperature upon pumpability of neat Portland cement slurry, made of 4½ gallons water to one sack of cement.

tom-hole pressure to be applied is one pound per square inch per foot of depth to the horizon." To determine surface pressure deduct the value of the hydrostatic head of the fluid column in the hole.

The first formula is preferable, as it will more nearly approach the pressure obtained when no more slurry can be displaced into the horizon. For example, consider a job using a 15-pound slurry and depth to the horizon of 3000 feet. Using the first formula, the permissible surface squeeze pressure would be 2200 pounds per square inch; using the second formula, the permissible surface squeeze pressure would be 750 pounds per square inch, or approximately one-third of the pressure obtained by the first formula.

It has been the writer's experience that surface squeeze pressures necessary to obtain a successful shutoff, or that pressure where no more slurry could be displaced with a gradual increase of pressure but when a sharp increase in pressure is obtained, and for the successful exclusion of water, were on the order of 3000 pounds per square inch or more. The writer has also found it necessary to use surface squeeze pressures of 3000 pounds per square inch or more to obtain a shutoff for reduction of high gas-oil ratios. These pressures were used in depths from 3000 to 5000 feet.

Methods and Equipment Used

Early squeeze methods made use of tubing or drill pipe, run open-ended in the hole, which was full of mud or water. The wellhead was then packed off, and the cement pumped down the tubing and forced into the formation or behind the casing. This method required that the squeeze pressure on the tubing and the annulus be the same. This practice was hazardous, especially with the old, lap-weld pipe, as the pressure would often cause the pipe to split. Another one of the early methods was to pump the cement into the casing and follow it with a plug, pumping the cement into the formation or behind the pipe.

Present methods employ retrievable cement retainers and bridging plugs, which are placed in the well at some pre-determined depth and the cement pumped through the retainer or plug into the formation through perforations behind the casing.

Techniques employed require that the wellhead be equipped with a blowout preventer, or a high pressure stripper head of some type to pack off the annulus on the tubing or drill pipe.

It is desirable to have the hole loaded

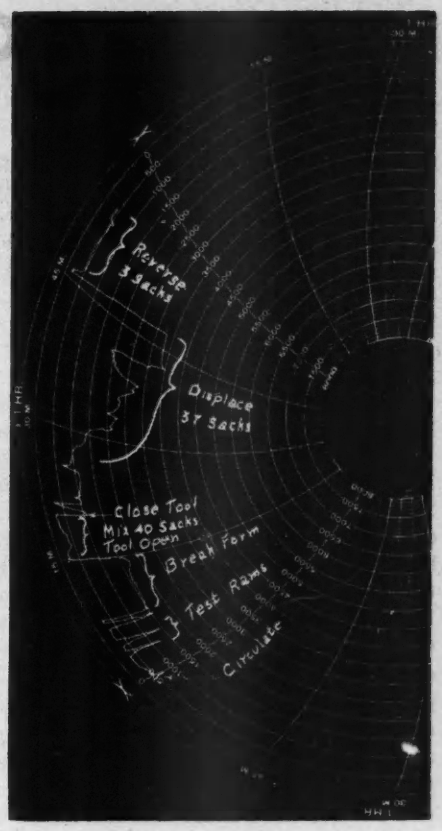

FIGURE 2

with fluid, either mud, water, or oil. However, it is sometimes impossible to have the hole loaded, as some zones will break down under the hydrostatic pressure of the fluid in the hole and will "thief" the load fluid until after a batch of cement is squeezed into the zone.

If mud is used to load the hole it must be clean and free from cuttings or trash which might settle and stick the squeeze tool in the hole. Also, if mud is in the hole and pressure has been applied to break down the formation, it is desirable to spot ten to 20 barrels of water ahead of the cement. The water will wash the formation and flush ahead of the cement any mud which may have been thiefed by the formation, and thus help insure a good bond between the cement and formation, or sand particles. It is also desirable to spot ten or 20 barrels of water behind the cement if mud is used for displacing the cement. The water will serve to flush the perforations clear of cement in the event a shutoff is not obtained and it is necessary to put in another stage.

When the hole is ready, the squeeze tool is run into the casing on tubing or drill pipe to some predetermined depth above the perforations or zone into which cement is to be squeezed. Pressure up to 1000 or 1500 pounds per square inch should then be applied to all wellhead connections to test for leaks. It is very important that there are no leaks, as it would be impossible to test for a shut-

■ CONTINUED ON PAGE 140

TABLE 1

Date	5-19-45	5-20-45	5-20-45	5-21-45	5-21-45	5-22-45	5-22-45
Stage	1	2	3	4	5	6	7
Time started circulation	1:45 PM	7:00 AM	6:00 PM	7:00 AM	6:20 PM	7:00 AM	7:15 PM
Pressure to break formation	900 lb.	1200 lb.	1350 lb.	1800 lb.	3400 lb. 2000 lb.	3400 lb. 2400 lb.	2650 lb. 2000 bl.
Kind cement No. sacks mixed	Slowset 40	Slowset 40	Slowset 40	Slowset 40	Slowset 40	Slowset 40	Portland 40
Condition of tool, jars open or closed while mixing cement	closed	open (closed) (9.5 bbl.)	open (closed) (8 bbl.)	open (closed) (8 bbl.)	closed	closed	closed
Displacement (Barrels)	Pressure (Pounds)						
13	750	850	1000	1200	2200	2100	2350
14	750	850	1000	1200	2350	2100	2100
15 cement @ perf.	750	850	1000	1200	2450	2200	2500
16	750	850	1000	1250	2250	2350	2700
17	800	900	1100	1600	2000	2400	2750
18	900	1050	1200	1750	1950	2000	2850
19	900	1200	1400	1850	2000	2100	2750
20	1050	1350	1550	1900	2000	2250	2900
21	1150	1450	1700	2000	2050	2400	3050
22	1250	1550	1800	2050	2050	2500	3000
22.5	....	....	....	....	....	....	3250
23	1300	1650	1800	2050	2050	2450	P.U.T.†
24	1300	1650	1650	2050	2050	2400	B.W.‡
	Brk*	Brk*	Brk*	Brk*	Brk*	Brk*	....
25	1250	1600	850	1900	1500	2000	....
26	1250	1200	1500	1500	P.U.T.†	P.U.T.†	
26.5	....	....	1500	1500	....	....	....
27	850	1150	P.U.T.†	P.U.T.†	....	....	....

* Pressure dropped because cement was completely displaced and water passing perforations.

† Picked up tool means that the squeeze tool was picked up, usually from 20 to 25 feet; the tubing closed in and the excess water pumped down the annulus, thus washing any cement above the tool down the hole to prevent sticking the tool in the hole.

‡ Backwashed or reverse circulated by pumping down annulus until the capacity of the tubing had been displaced, thus washing from the tubing any excess cement that was not displaced.

Production of Crude Oil by Solution in High-pressure Water

ONLY SLIGHTLY soluble in water at atmospheric pressures, crude fractions, particularly the lighter ones, are shown by laboratory experiments to be dissolved in worth-while quantities at high pressures. The author describes the tests and indicates possible production gains through high-pressure flushing of apparently depleted sands.

IT IS common knowledge that crude oil can be removed from some oil sands by mechanical and hydraulic action (pushing and dragging) of driving water. It is not so well known that large quantities of oil may be removed from an oil sand because of the solubility in high-pressure water of some constituents of crude oil. The purpose here is to report and discuss the results of a reconnaissance investigation of the solubility of crude oil in water and of the quantities of oil which may be removed from sand as a result of such solubility.

At atmospheric pressure and temperature, some of the light ends of crude oil are known to be slightly soluble in water. The following values have been reported:

n Butane at 15° C.:
2.147 volumes per 100 volumes of water
n Pentane at 16° C.:
0.06 volume per 100 volumes of water
n Hexane at 15.5° C.:
0.021 volume per 100 volumes of water
n Heptane at 15.5° C.:
0.0073 volume per 100 volumes of water
n Octane at 16° C.:
0.002 volume per 100 volumes of water

The writer has seen no reported solubility figures for these or other constituents of crude oil at high pressures.

Solubility at Atmospheric Pressure

The first solubility investigation was conducted at atmospheric pressure and room temperature. Two sealed cells were used, one for the solution, one for control. The contents of the cells were as follows:

	Test Cell	Control Cell
Bradford crude oil, 46.6° API (60° F.)	10 cc.	10 cc.
Water	2000 cc.	none
Air	250 cc.	250 cc.

The index of refraction of the crude at 68° F. was 1.4470. The sealed test cell was agitated for a period of six days, following which the oil and water were separated by gravity. From this work the following data were obtained:

	API Gravity at 60° F.
Oil from control cell	42.82°
Oil from test cell	41.86°

Before the test, the water showed no fluorescence under ultra-violet light. After the test the water fluoresced brightly and had a strong petroliferous odor, indicating the presence of some crude constituents in solution. Under the circumstances of the test it was impracticable to determine by material balance the quantity of oil dissolved. From an evaporation curve for the specific crude used, the following reductions in volume are indicated by the measured gravities:

	Volume Reduction
From 46.6° to 42.82° API	8.2 percent
From 46.6° to 41.86° API	11.0 percent

The volume reduction of the oil from the control cell was due to evaporation after opening the cell. The volume reduction of the oil from the test cell was due both to solution in water and to evaporation after the cell was opened. Although the oils from both cells were treated as nearly alike as possible, it cannot be known that the evaporation losses were identical. Because of the lower gravity of the oil from the test cell, it is very unlikely that the evaporation loss from it was greater than that from the oil from the control cell. It may have been less. But assuming identical evaporation losses, 2.8 percent of the 10 cc. of oil in the test cell, 0.28 cc. was dissolved in the 2000 cc. of water; the rate would be 0.014 volume of oil per 100 volumes of water. At that rate, 1000 barrels of water in passing through oil sand in intimate contact with oil could dissolve 0.14 barrel of oil and hold it in solution at atmospheric pressure. This is not very much.

In the above approach, it was assumed that the same volume-gravity relation holds whether the crude is reduced by evaporation or by selective solution. By experiment it has been determined that, for a particular Bradford crude, by changing the density by evoporation

$$\text{Index of refraction} = 1.1059 + 0.43 \times \text{density}$$

Different samples of Bradford crude vary somewhat in heavy-end content and in color. The result is some variation in the first constant above, but very little in the slope of the curve.

For the high-pressure solution oil reported below, the equation is

$$\text{Index of refraction} = 1.1149 + 0.415 \times \text{density}$$

as determined for the same oil before and after being exposed to solution in high-pressure water. The almost identical slopes of the two curves justifies the assumption that the volume-gravity relation holds, within the limits here concerned, whether the crude is reduced by evaporation or by selective solution in water.

Solubility at High Pressure

The test and control cells for the high-pressure solubility investigation

were made from ordinary 2-inch by 12-inch tubing nipples, fitted with reducers at each end. To develop a large oil-water interface, the cells were filled with clean silica sand. The charging apparatus is shown in Figure 1. In order to minimize evaporation during charging, the entire apparatus was chilled before the charging started. Dry ice was used for this purpose. For the same reason, dry ice was used at the end of the test, while handling the oil. The oil entered the bottom of the cell from the right reservoir, slowly filled the cell and then moved into the reservoir over the cell. Both reservoirs were fitted for temperature and gravity measurements. The first oil through the cell was slightly lighter in color than that entering, but there was no measurable change in the gravity of the oil in moving through the system. In all, 1000 cc. of oil entered the system. The capacity (pore volume) of the cell was 283 cc. of liquid.

Of the 283 cc. of oil charged to the cell, 63 cc. was removed by gravity drainage and 176 cc. additional oil was removed by a water drive. The cell then contained 44 cc. of oil with water. The cell was sealed, pending the test. The control cell was similarly charged with 51 cc. of oil.

The cells were set up as illustrated in Figure 2, test cell to left, control to right. Water at 1100 psi was supplied through the pipe at the top center. No water flowed through the control cell, but it was always under the same water pressure as the test cell. A needle valve at the left end of the test cell held the full pressure on the cells and controlled the rate of flow of water through the test cell and into the glass receiver at the lower left. Water was removed from the receiver periodically for measurement and inspection under ordinary and ultraviolet light.

Observations

1. Throughout the first 20 days, a slight scum of oil accumulated daily on the water in the receiver. The quantity

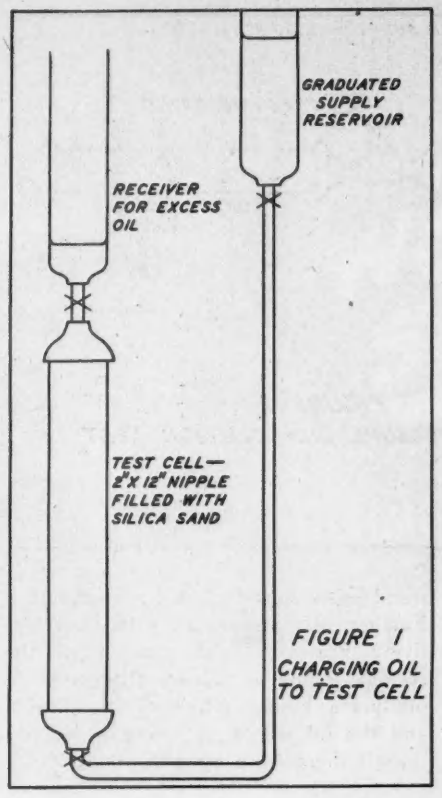

FIGURE 1
CHARGING OIL TO TEST CELL

was too small to measure by the means at hand. This oil could have been removed from the cell either mechanically or in solution in the high-pressure water.

2. During the early part of the test, the water upon entering the receiver was milky in appearance and had a strong gassy odor. The milky appearance, caused by tiny gas bubbles, gradually disappeared with time. The gradually-disappearing milky appearance sometimes noted in water taken from a hot-water faucet is a similar phenomenon. Water taken direct from the high-pressure water line did not behave in this manner. The "gas" was light ends of the oil in the test cell, dissolved at high pressure, and forced out of solution at the time of reduction in pressure at the needle valve.

3. Throughout the entire time of the test, the discharge water would fluoresce under ultraviolet light, at first very brightly, at the end weakly but definite. The supply water was not fluorescent.

4. During the first half of the test period, the ultraviolet light also revealed the presence of innumerable droplets of oil suspended in the water. This was indicated by many very bright fluorescent "pin points."

Statistics of High-Pressure Test

	Test Cell	Control Cell
Quantity of crude oil at start	44 cc.	55 cc.
API gravity at 60° F.	46.60°	46.20°
Index of refraction at 68° F.	1.4470	.....
Water pressure	1100 psi	1100 psi
Duration of test	33 days	33 days
Volume of water through cell	66,192 cc.	None
Average rate	2006 cc. per day	0
Quantity of oil residue removed by soda	17 cc.	25 cc.
API gravity at 60° F.	39.64°	43.43°
Index of refraction at 68° F.	1.4553	.....
Quantity of oil residue removed by pentane	9.06 cc.	11.76 cc.
API gravity at 60° F.	38.86°	38.86°
Residue oil removed by soda (adjusted to 46.60°)	21.1 cc.	(46.20°) 26.6 cc.
Residue oil removed by pentane (adjusted to 46.60°)	11.7 cc.	(46.20°) 15.1 cc.
Total oil recovered from cells (adjusted to 46.60°)	32.8 cc.	(46.20°) 41.7 cc.
Mechanical loss of oil	11.2 cc.	9.3 cc.
Mechanical loss as percent of original content	25.5%	18.2%

Discussion on Results

At the end of the run, oil was removed from the cells first with the aid of a weak soda solution. This was followed by pentane extraction and reduction. The cleaned sand from both cells was somewhat darker in color than it was originally. A very small quantity of highly-pigmented material from the crude oil was strongly adsorbed on the sand. Hence the lighter color of the oil first through the cell at the time of charging. The quantity involved was too small, fractionally, to affect the gravity measurements of the oil. Special tests showed that the soda solution had no influence on the density or index of refraction of the oil. The quantities of oil removed are shown in the table above.

The mechanical loss indicated is not due to evaporation nor to selective solution. The loss from the control cell occurred during the manipulation after the test. The loss from the test cell was similarly due to the manipulation plus any oil the water may have removed mechanically from the cell. If the manipulative losses were identical volumetrically, the water pushed or dragged 1.9 cc. (4.3 percent) of oil from the test cell. If the manipulative losses were identical percentagewise, the figure would be 3.2 cc. (7.3 percent). This would indicate that some of the oil forming the scum in the receiver had been mechanically removed from the test cell. As the exact quantity cannot be evaluated, the material-balance method for determining the quantity of oil dissolved cannot be used. But the reduction in API gravity is significant.

Control cell: Reduction in volume due to evaporation during manipulation after test run (46.20° to 43.43° API) from evaporation curve 5.9 percent

Test cell: Reduction in volume due to evaporation during manipulation after test run plus solution of light ends of crude oil in water during test run (46.60° to 39.64° API) from evaporation curve 19.9 percent.

The exact part of the 19.9 percent volume loss chargeable to evaporation dur-

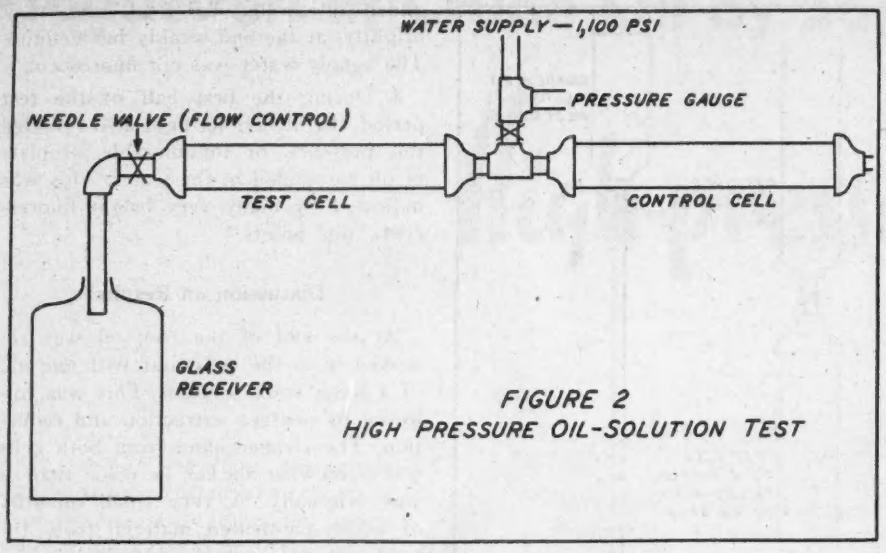

FIGURE 2
HIGH PRESSURE OIL-SOLUTION TEST

ing manipulation after the test cannot be known. It is known that Bradford crude reduced by evaporation to 40° API gravity evaporates very much more slowly than that reduced only to 43° API gravity. The manipulative treatment of the oils from the two cells was essentially identical. Hence it is proper to assume that a volume reduction of at least 14 percent was due solely to the solution in water at high pressure of the light ends of the crude oil. It seems probable that the volume reduction due to solution was in the order of 18 percent.

In normal good water-flood operation in the Bradford field, a common average experience is as follows:

Ultimate oil production from one 5-spot .....10,000 barrels
Ultimate water production from the same 5-spot .....200,000 barrels
Oil remaining in the same 5-spot at time of abandonment..10,000 barrels

At Bradford, most of the oil removed mechanically from any point in the sand is removed before the driving water can dissolve any part of it. Therefore, the solvent action is restricted to the oil remaining at each point in the sand after the mechanical expulsion of oil from that point is essentially complete. In Bradford field operation, if the solution in the flood water of the residual oil is of the same order of magnitude as indicated in the test cell, the 10,000 barrels of oil remaining in the sand is the heavy residue after solution, and the quantity of oil removed would be

1627 barrels minimum
2195 barrels probable.

Therefore, on the basis of this reconnaissance investigation, in Bradford water-flooded operations it is possible that at least 15 percent of the oil removed from the sand is removed by a process of true solution in high-pressure water rather than by the ordinarily understood pushing-and-dragging mechanism. Further, the process of solution selectively removes light ends from the residual crude oil. Hence the produced oil has a higher gravity (it is lively) and the oil left in the sand is heavier than if there were no solvent action.

Field Evidence of Solution of Oil in High-Pressure Water

In a water-flood operation, the quantity of oil actually removed from the sand by solution in water would depend in part on the water pressure in the sand and on the quantity of water flowing through the sand. In a modern Bradford water flood, the sand near an intake well is likely to be under a pressure in excess of 2000 pounds per square inch, with a large volume of water (unsaturated with oil) flowing through it. Near a producing well, the pressure in the sand will be very low. Water flowing through the sand at that point may have been saturated previously with oil. The solvent action is likely to be very effective near the intake wells. Near the producing wells there may be little or no additional oil dissolved in the water.

Water flowing through the Woodbine sand at East Texas is under high pressure. The work reported here suggests that water may be removing large quantities of oil from that sand by solution.

Data from two Bradford water floods were studied in a search for evidence as to whether or not oil is in fact removed in quantity from sand by solution. In the southeast part of the Coit property some wells were drilled through watered-out sand near existing intake wells. The old intake wells had taken water for years at a sand-face pressure of approximately 1200 psi. Other nearby wells were drilled in sand in which no flood water had appeared at the time of drilling. All these wells were tested, the oil being extracted from the sand samples with pentane. The extraction process began within a few minutes of the time the samples were cut. Immediately after extraction and reduction the gravity of the oil from each sample was separately determined. The oil in unflooded sand in the Coit property has a gravity of about 48° API at 60° F. In the process of removing the pentane solvent from the oil samples, some of the lightest ends of the oil are unavoidably removed. The resultant volume of oil is therefore corrected to the initial volume with the aid of an evaporation curve prepared from that specific crude oil. The following was found:

Average of 28 samples, no flood water, no correction.....40.11° API
Volume loss from 48° API
18.4 percent

Average of 35 samples, all watered-out (near intake wells), no correction .....36.75° API
Volume loss from 48° API
32.6 percent

Evaporation Losses

If the evaporation losses during reduction in both sets of samples were identical, the oil in the watered-out sand had undergone a loss of 14.2 percent of its volume in addition to the evaporation loss. But low-gravity oil does not evaporate as readily as does high-gravity oil. Hence it appears that the water in moving under high pressure through the Coit sand dissolved more than 15 percent of the oil remaining after the mechanical driving of oil was complete.

Similarly, in the northwest part of the Lincoln property, test wells were drilled in sand through which water, under a sand-face pressure of about 600 psi, had moved for many years. Some test wells were also drilled in nearby sand through which no water had moved at the time of drilling. From the test data:

Average of 13 samples, no flood water, no correction (Wells No. 55 and G4) .....40.03° API
Volume loss from 47.5° API
18.8 percent

Average of 14 samples, all watered-out, no correction (Well No. F6, near old intake well)....37.50° API
Volume loss from 47.5° API
29.3 percent

After well No. F6 had been taking water for some six years at a sand-face pressure of about 2000 psi, a test well was drilled 105 feet from it. From the test data from that well:

Average of 23 samples, all watered-out, no correction .....37.46° API
Volume loss from 47.5° API
29.4 percent

If the evaporation losses during re-

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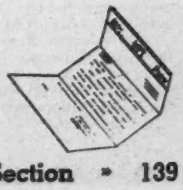
PHONE **WIRE** **OR WRITE** 

duction of the first two sets of Lincoln samples were identical, it appears that solution in high-pressure water was responsible for a minimum reduction in residual oil volume of 10.5 percent close to the intake well. Similarly, the data indicate that the combined floods were responsible for a minimum reduction in volume, due to solution, of 10.6 percent at a location over 100 feet from the intake wells. But, as before, it is unlikely that the low gravity oil evaporated proportionately as much as the higher gravity oil. Hence it may be that the flood water dissolved 15 percent or more of the oil in the sand at the time the process of solution began.

Conclusions

None of the work done so far in the determination of the solubility of crude oil in water at high pressure has been of a truly quantitative nature. But that work does indicate that some of the lighter constituents of crude oil are soluble in water at high pressure. It indicates further that in a normal Bradford water flood, at least 10 percent of the oil remaining in the sand (at the instant water has driven out the mobile oil) is subsequently removed from that sand by solution in the water moving through. The actual quantity removed is not known, but it is probably on the order of 15 percent and may be as high as 20 percent.

As the pressure of the water is reduced, oil comes out of the solution. At atmospheric pressure very little of it is retained. Of the oil from solution, some is no doubt delivered at the surface as casinghead gas. But most of it may be expected to associate itself with the oil in the producing wells, or in the sand near them, increasing the volume and gravity of the produced oil. The higher the pressure used for the water flood, the greater should be the quantity of oil removed from the sand by solution.

These findings suggest a need for including pressure considerations in laboratory water floods where such floods are intended to simulate field conditions. True quantitative investigations of the phenomenon here discussed are needed.

ACKNOWLEDGMENTS

The laboratory work reported here was done by Francis R. Conley, to whom credit is due for much of the successful detail planning and observation. The high-pressure operations were carried out in the pressure plant of the Kendall Refining Company at East Bradford. Index-of-refraction measurements were made by William Hulme in the laboratory of the Kendall Refining Company. All other laboratory work was done in the laboratory of the Ryder Scott Company. The field data reported here were made available by the Smith-Newton Oil Company and the Kendall Refining Company. The Penn Grade Crude Oil Association provided funds for the special test well on the Lincoln property. The work and cooperation of these individuals and firms are greatly appreciated.

Squeeze Cementing

• CONTINUED FROM PAGE 135

off if the pressure leaked off through the connections. All tubing joints should be made up tight, to eliminate any collar leaks, as cement which might leak through the collars could stick the tool in the hole. After testing for leaks, pressure is then applied to the formation to break down resistance of the formation to the injection of fluid.

The volume or the capacity of the tubing, as well as the volume of the casing from below the squeeze tool to the top of the perforations and to the bottom of the perforations, should be calculated as accurately as practical. It is necessary that these calculations be determined in order to ascertain the volume of fluid necessary for the complete displacement of the cement from the casing, and to enable the operator to determine the amount of cement displaced at any time during the displacement period. A check as to the volume of cement displaced can be made by using the water tanks on the mixing truck and counting the barrels of displacement fluid pumped.

The following is an example of an actual squeeze job performed on a well in Garvin County, Oklahoma, for the exclusion of salt water.

Depth of well: 3851 feet.
Size of casing: 5½-inch, 14-pound.
Capacity: barrels per foot = .0244.
Perforations: 3834 to 3851 feet.
Type of squeeze tool: Retrievable, run on 2½-inch EUE tubing.
Tubing: 3814 feet, 2½-inch EUE.
Capacity: Barrels per foot = .00579.
Tool set at 3820 feet.

		Bbls.	Bbls.
Volume of tubing in barrels	(3814 × .00579)	= 22.08	22.08
Volume of casing to top of perforations below tool	(3834 — 3820 × .0244)	= .34	
Volume of casing to bottom of perforations below tool	(3851 — 3820 × .0244)	=	.75
Volume of fluid in pump and lines		= .70	.70
Total fluid to top of perforations		= 23.12	
Total fluid to bottom of perforations		=	23.53

Table 1 is a log of the above squeeze job which was performed in stages. The writer has found the following method of recording a squeeze job very useful, especially if it is necessary to do the work in stages, as it permits correlating the results of each subsequent stage with the preceding stage, and this log is given only for the purpose of demonstrating the method of recording a squeeze job.

During the backwashing procedure it is important that the pressure on the annulus and tubing be maintained at or above the pressure obtained while placing the cement. If this backwash pressure is not kept high, the displaced cement will sometimes backflow into the casing and seal off the perforations so that the next stage cannot be placed.

Figure 2 shows graphically the changes in pressure during an actual squeeze job.

Displacement Rates

Displacement rates vary and are naturally high while the pressures are low, and decrease as the squeeze pressure increases. It has been the experience of the writer that better results are obtained if the truck pump drive is shifted into a low gear, usually second, at the beginning of the displacement of the cement. This is to provide ample power during displacement to avoid the necessity of having to stop pumping and shift into a lower gear, an operation which permits the cement to come to rest temporarily, and should be avoided when the pressure is high and there is considerable cement to be displaced. Using the low gear permits displacing the cement at a fairly uniform rate, and prevents excessive dehydration of the cement.

It is a practice of the squeeze-tool operators, especially in the latter stages of a job when the pressure is high and the volume of cement left to be displaced is low, to stop the pump and let the cement come to rest for five or ten minutes, then resume pumping. This practice is followed during the latter stages of a job to secure a shutoff to avoid having to place another batch. This practice should not be permitted, if it is possible to avoid it, as cement which is disturbed after taking initial set is apt to be fissured and permeable, resulting in an unsuccessful job. Frequently the squeeze-tool operators, for some reason, want to "hesitate," shut down the pump during the early stages of displacing the cement. This should not be permitted as it will prevent getting sufficient cement behind the casing or into the formation for a shutoff, and thus result in an unsuccessful job.

Conclusion

In conclusion, a successful squeeze job will be more easily obtained if the operator has on hand the right type of cement necessary for the job; if the hole is clean and the mud free from cuttings; and the fittings and equipment are sound. Sufficient cement and water should be on hand and used to secure a job as few stages as possible, as cement is much cheaper than rig time or rental on squeeze-tool equipment.

ACKNOWLEDGMENTS

Assistance and comments from certain squeeze-tool operators of the Halliburton Oil Well Cementing Company, Baker Oil Tools, Inc., and W. F. Cloud of the University of Oklahoma have been most helpful in the preparation of this paper.

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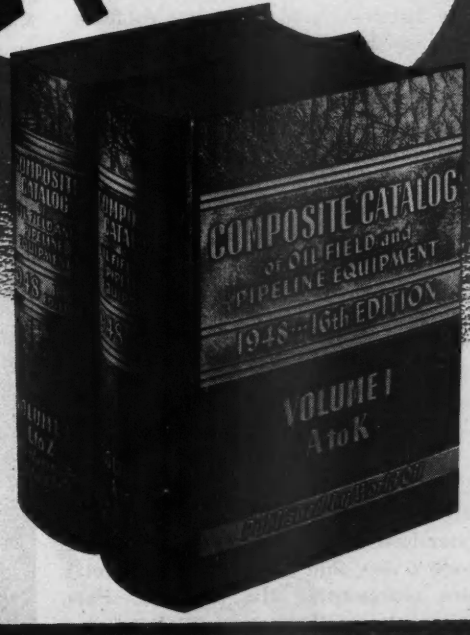

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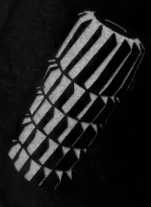

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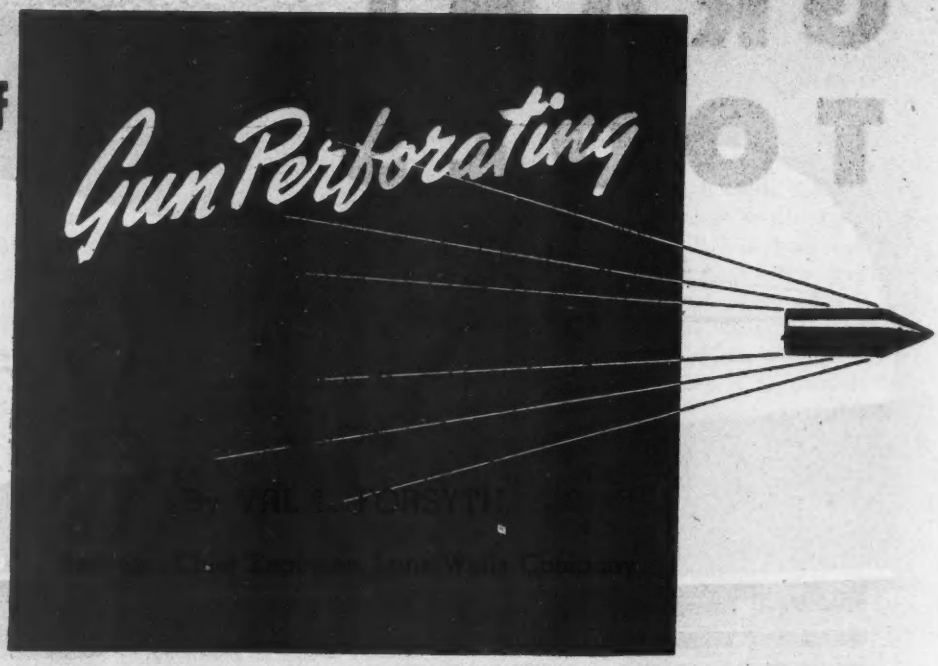
A Study of Gun Perforating



Part 2

The Effect of Gun Perforating Upon Cement and Formation

ANY investigation of gun perforator performance would not be complete unless it included an analysis of the effects of gun perforating upon cement and formation. Such an investigation requires a thorough knowledge of cement behavior and cement problems. For such knowledge it was necessary to rely entirely upon the personnel and test facilities of the research laboratories of one of the major oil companies.

Preliminary to study, and in the interest of an orderly presentation, this discussion has been subdivided into four classifications which deal with *Correlating Surface and Subsurface Results, The Effect of Gun Perforating Upon Neat Cement, The Effect of Gun Perforating Upon Formation, and The Effect of Adding Bentonite to Cement.*

CORRELATING SURFACE AND SUBSURFACE RESULTS

At the surface standard test barrels were used (Figure 1). For these tests a standard barrel consists of casing set inside a very thin eight inch sheet metal form representing the borehole. Formation surrounding the well bore was of two types:

(a) Concrete, consisting of an aggregate of one part high early strength cement and two parts washed river sand, with a compressive strength above 5000 pounds per square inch and a tensile strength of about 485 psi. This was utilized to represent dense limestone or sandstone.

(b) Loose sand, composed entirely of river sand washed and tamped into place, was utilized to represent very unconsolidated formation.

In the subsurface tests a joint of five-inch—18-pound No. J-55 casing was cemented inside seven-inch—28-pound N-80 casing. The test specimen was run on a string of 5½-inch casing to a depth of about 6500 feet under 10 pounds per gallon mud. Bottom hole temperature readings were taken at intervals to judge the temperature existing subsurface. Through the use of laboratory data compiled with specially designed equipment the oil company personnel were able to accurately determine the strength of the subsurface neat cement at the time it was perforated.

Gun perforating operations continued over a period of three or four days. The

FIGURE 1.—A standard test barrel.

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time intervals were carefully established and correlated to cement strength to permit the subsurface specimens to be compared with the specimens tested in surface tests. Thus, there was an elimination of confusing variables and study was directed towards the effects of gun perforating upon the cement and casing.

In both subsurface and surface testing the gun perforating equipment was composed of both the 3⅝-inch O.D. and the 4⅛-inch guns† using standard powder charges. Bullet sizes included the ⅜-inch and the 15/32-inch diameter bullets, but in all cases the ⅜-inch bullet utilized a jacket. The use of jackets in burr removal has been previously described in Part I.

The exact time the subsurface samples of cement were allowed to set and the temperature existing at the subsurface point have not been fully released for publication, because the interpretation of these data involves laboratory research information not considered necessary to the completeness of this paper. The waiting times were from about ten hours to about three days (72 hours), and the cement strength is judged to have varied from 80 psi tensile to 370 psi tensile (Table 1).

Discussion of Results

Detailed results will be fully described later in this article. It is sufficient to say that there was excellent agreement between the amount of cracking obtained subsurface as compared to the neat cement cracking encountered at the surface, with specimens of equivalent neat cement strength.

TABLE 1

Shot-By-Shot Analysis of Neat Cement Cracking Tests

Bbl. No.	Neat Cement: Age; Hours	Neat Cement: Lbs./ Sq. In. Tensile	Shot No. in Bbl.	Hole Size in Neat Cement	Condition of Neat Cement
*B	28	20	1	2¼"x1⅞"	Each shot produced at least one short vertical crack. Each shot left ragged weakened area immediately around hole (See Figure 3).
			2	2¼"x2¾"	
			3	2¾"x3"	
			4	2¾"x2¾"	
*5	26	36	1	3½"x4"	One short wide crack.
*14	26	36	1	1¾"x1¾"	Clean, round hole—no cracking. (See Figure 4).
*A	45	65	1	1¾"x1¾"	One short, vertical crack. (See Figure 3).
			2	2½"x2¼"	
*A	45	65	3	1¾"x1¾"	Very badly shattered large area weakened, peeled from casing—One vertical crack.
			4	1¾"x1½"	
*2	43	80	1	2" x2"	Fairly clean hole—no crack.
*7	43	80	1	2½"x3½"	Ragged hole, weakened at each end, no positive cracking.
*10	72	180	A	1¾"x1¾"	Old style bullet—no cracking.
			B	⅜"x ⅜"	Old style bullet—no cracking.
			C	⅜"x ¾"	Ogival bullet—no cracking.
			D	1½"x1¾"	Ogival bullet—no cracking.
NOTE: Shots A and D on same side of Bbl. produce larger holes. (See Figure 11.)					
*9	75	190	1	1⅝"x1⅝"	Relatively clean holes no cracking at any shot. (See Figure 10).
			2	1¼"x1¼"	
			3	1¼"x1¼"	
			4	1½"x1¾"	
*1	144	245	1	2" x2½"	Large area cement weakened around shot—no cracking.
*8	144	245	1	1¼"x1¼"	No cracking—fairly clean hole—not much weakening of cement.
4	145	307	1	¾"x1"	Clean shot holes; small amount of random cracking. Small area of cement weakened. (See Figure 7).
			2	¾"x ¾"	
			3	⅜"x ⅜"	
			4	⅝"x ⅝"	
*11	145	307	1	1⅝"x1⅝"	Slight cracks apparent.
			2	¾"x ⅞"	No cracks.
			3	1⅛"x1¼"	Slight cracks.
			4	1½"x1⅝"	Slight cracks.
NOTE: In Bbl. 11 cracking present to greater extent than in companion Bbl. 4. Cracking follows spider web pattern from shot hole.					
*3	264	350	1	⅜"x ⅜"	Cracked from each shot to great extent. Definite sunburst or spider web pattern, about each hole with random cracking away from the shots. Large area of weakened cement or cement actually removed around each shot hole. (See Figure 8.)
			2	⅝"x ⅝"	
			3	¾"x ¾"	
			4	⅞"x ⅞"	
6	264	350	1	⅜"x ⅜"	Serious cracking from each hole. Begins to show spider web or sunburst pattern. (See Figure 8).
			2	¾"x ¾"	
			3	½"x ½"	
			4	⅜"x ⅜"	
12	335	373	1	½"x ½"	(See Figure 5).
			2	½"x ½"	
			3	⅝"x ⅝"	
			4	⅝"x ⅝"	
13	335	372	1	⅞"x ⅞"	Sunburst and rotating cracks much heavier in sand barrel than in barrel backed up with concrete. (See Figure 5 and Figure 9).
			2	1" x1"	
			3	1¼"x1¼"	
			4	1¼"x1¼"	

* Even numbers represent concrete supported barrels with odd numbers representing sand supported barrels.
† Lane-Wells Company—Type A.

THE EFFECT OF GUN PERFORATING UPON NEAT CEMENT

Since it has been established that subsurface results coincide with surface results, and because surface specimens have been analyzed in detail, discussion of cracking and the attendant photographs will reflect only the surface test data. As mentioned earlier, the surface tests were made in concrete and sand supported test barrels.

Table I is a shot-by-shot analysis of the surface tests. Each barrel sample is numbered to permit easy identification and reference to tables of data. Odd numbered barrels utilized unconsolidated sand formation, while even numbered barrels were concrete formation. In Table I it should be observed that barrels are paired to some extent. Numbers 5 and 14, 2 and 7, 9 and 10, 1 and 8, 4 and 11, 3 and 6, and 12 and 13 are all paired in such a way that the neat cement is of equal strength, thus comparisons of sand and concrete support can be made. Curves I and II illustrate neat cement strength at time of perforating the test barrels. Temperature conditions varied from 90° F. to 40° F. over the period of the test. This variation accounts for the deformed curve.

Gun perforating equipment was composed of two sizes of selectively fired guns; the 3⅝-inch O.D. and the four-inch O.D. guns loaded with their standard powder charge. (See Figure 2.) In initial tests, conducted primarily to study cement cracking, only 15/32-inch bullets were used, although in later tests ⅜-inch, 15/32-inch and 9/16-inch bullets were used.

Discussion of Results

1. Cracking of neat cement is recorded in detail, in Table I. Apparently cracking does not occur until the strength has reach a point above 245 psi tensile. While this does not necessarily indicate that gun perforating should take place below 245 psi tensile, it is important to know that the range over which cement can be perforated without cracking is quite large and ranges up to 245 psi tensile. In terms of "time at surface temperatures," this involved 110 to 160 hours' interval from time of cementing; subsurface and at normal well temperatures the time would probably be reduced to about 48 hours, dependent upon the subsurface temperature.

Operators are cautioned against perforating when cement is too green. Just where this point occurs is not too clear and probably is a function of the subsurface temperature and the pressure differential tending to force green cement back into the perforations, with

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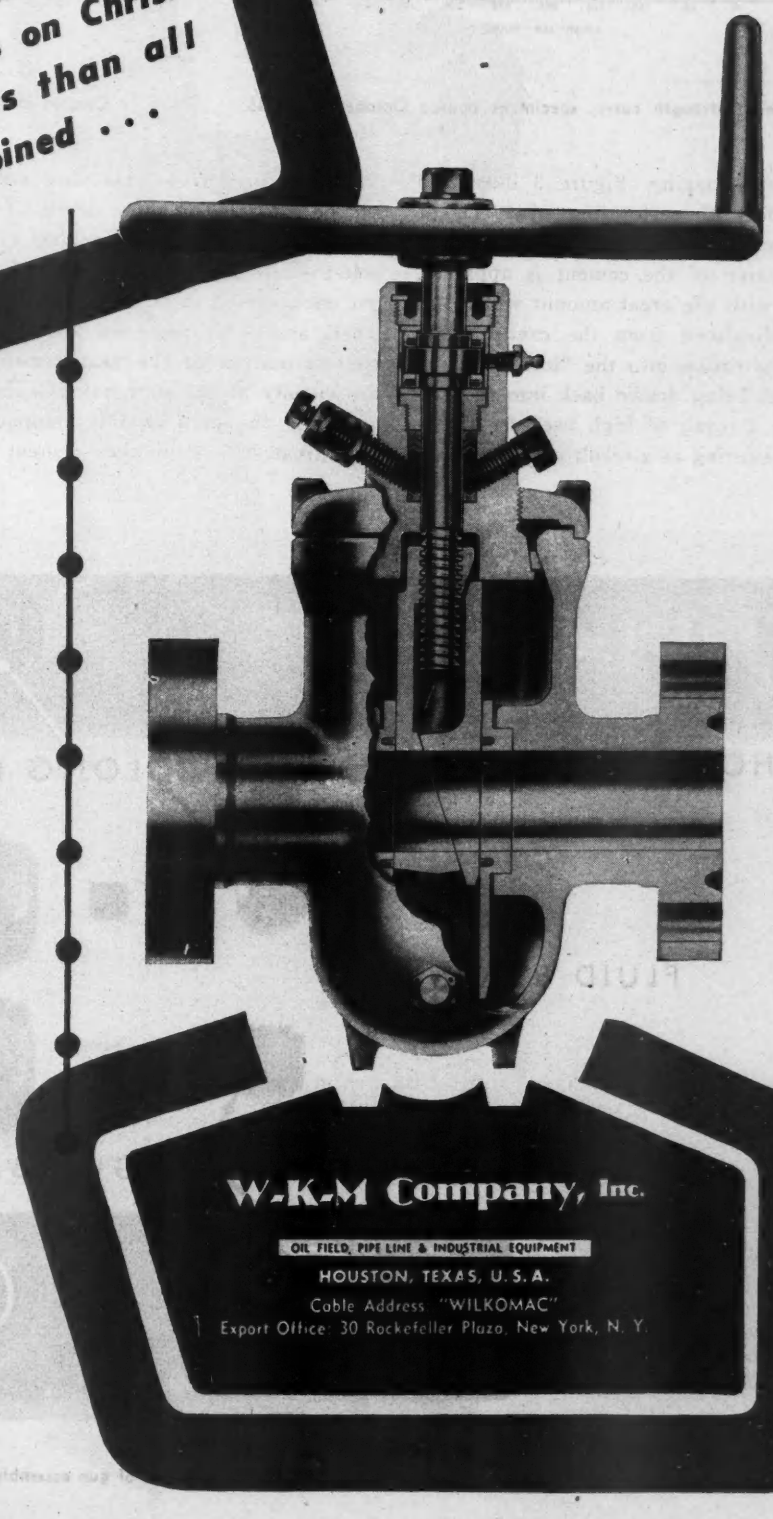

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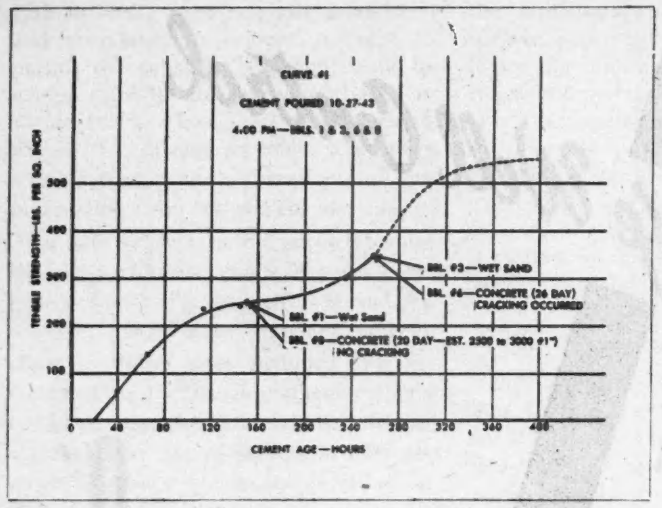
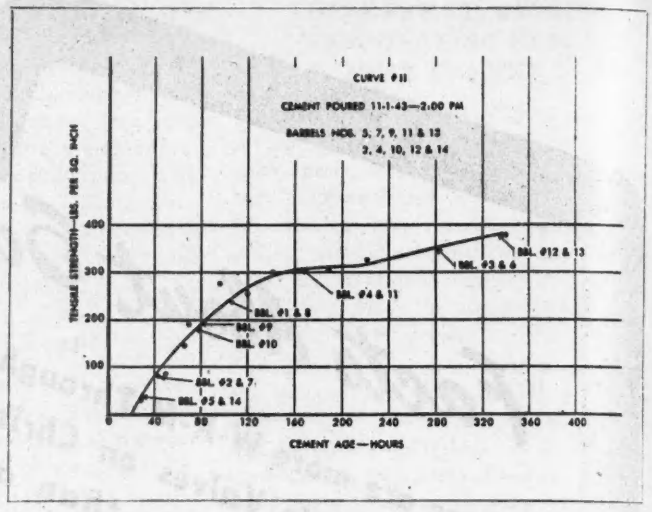


Cement strength curve, specimens poured October 27, 1943.



Cement strength curves, specimens poured November 1, 1943.

resultant clogging. Figure 3 illustrates the effect of perforating neat cement with only 20 psi tensile strength. The compaction of the cement is apparent, along with the great amount which has been displaced from the cavity either from extrusion into the "formation" or through being drawn back into the casing as a result of high pressure differential existing as a result of tremendous propulsive pressures. This phenomenon will be discussed in more detail.

2. While neat cement cracking, either hole-to-hole longitudinal or vertical, was not encountered at strengths of 245 psi tensile and under, there was a considerable compaction of the neat cement in the vicinity of the shot hole. Generally speaking, the area of this compaction was greatest with weaker cement and reduced in size as the cement gained strength. Compare Figure 4 with Figure 5. More specific information follows:

(a) There was less compaction or plasticity in the area adjacent to the bullet hole when neat cement strength remained below 36 psi tensile. (See Figure 3.) In general, particles were blasted out of position instead of being compacted. However, there were definite evidences

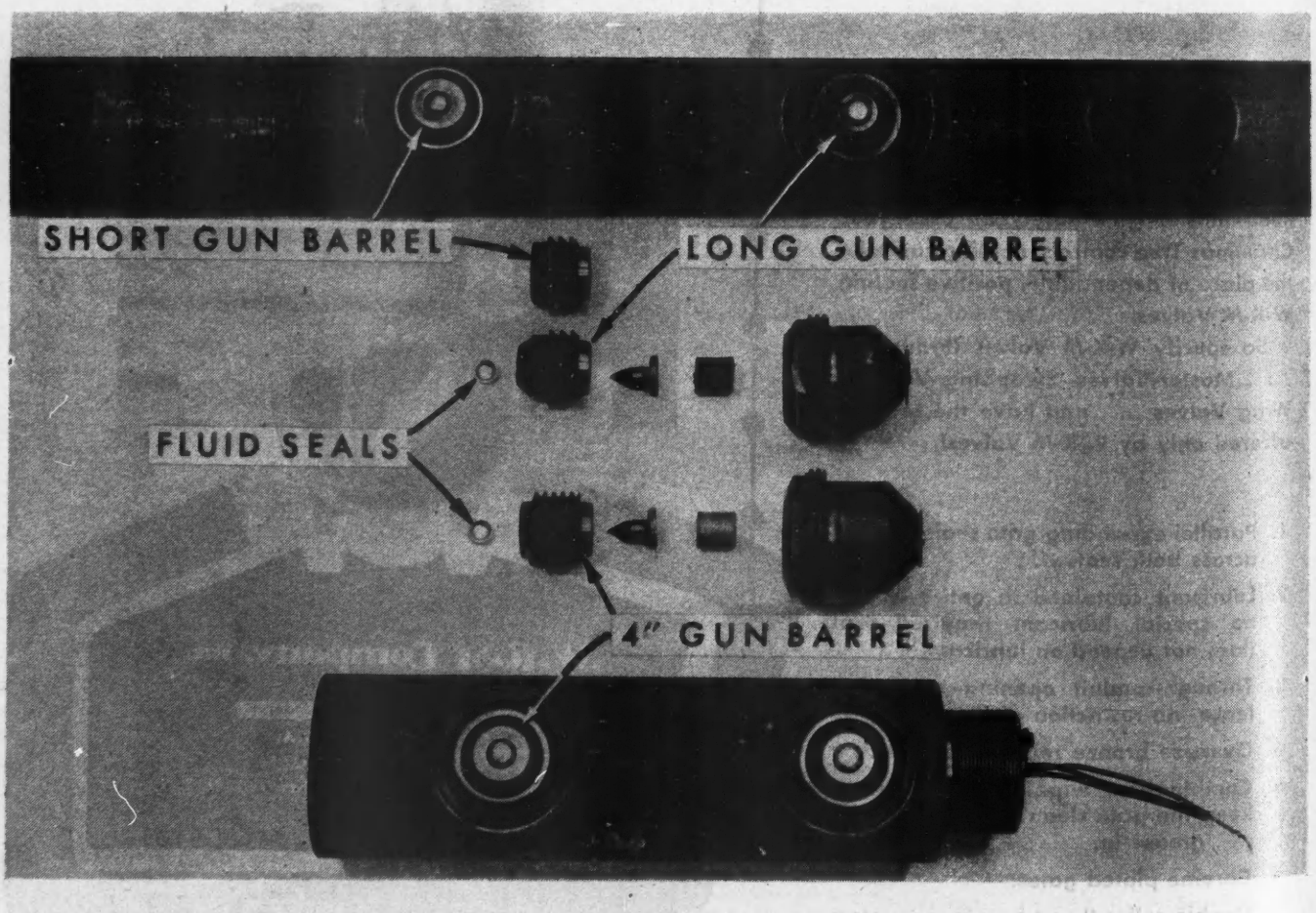
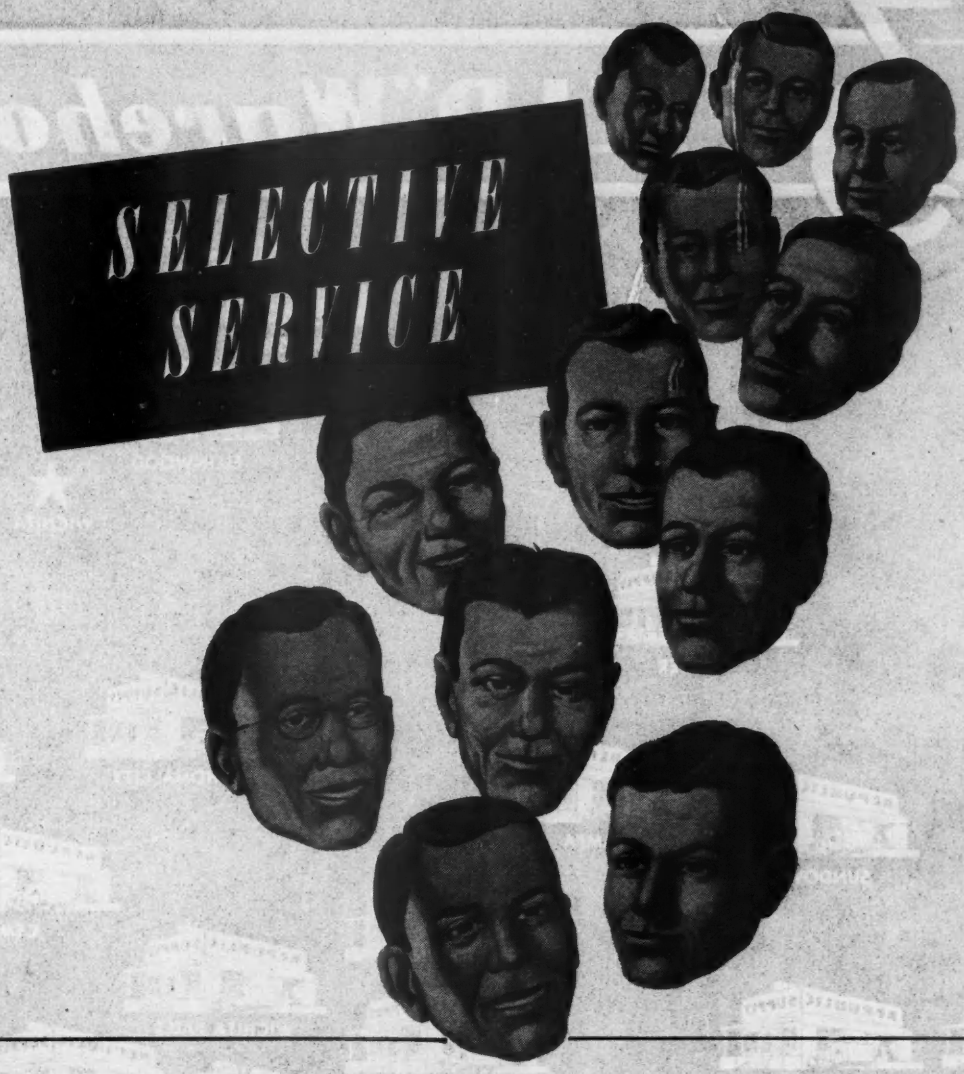


FIGURE 2.—Details of gun assembly.



CHAPTER FOUR OF

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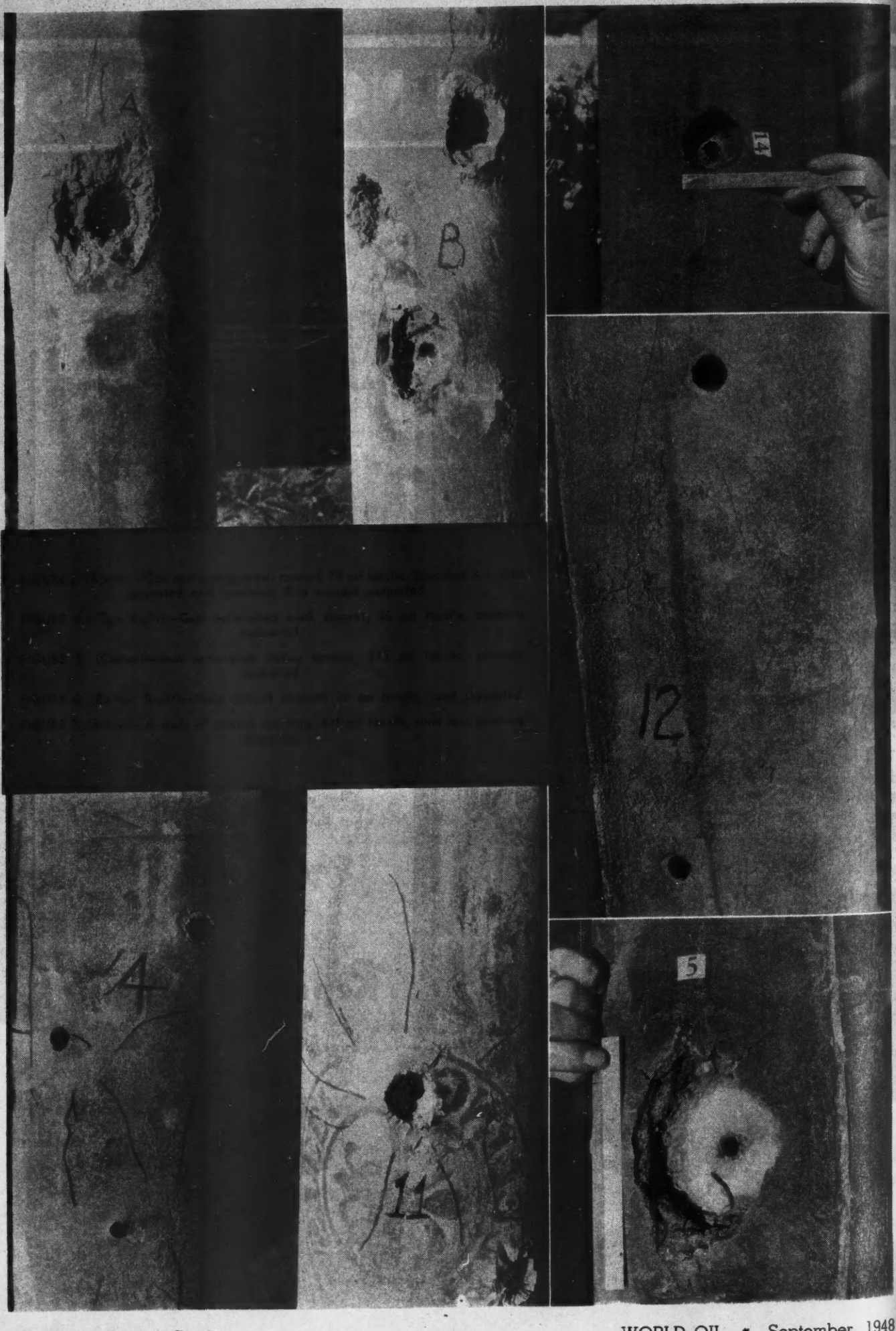
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Pump	Optional Plunger Dia.	Max. Fluid Pressure Lbs. per sq. in.	G.P.M. at 0 R.P.M.	G.P.M. at 60 R.P.M.	G.P.M. at 80 R.P.M.	G.P.M. at 100 R.P.M.	G.P.M. at 120 R.P.M.	G.P.M. at 140 R.P.M.
46-P 4½"x6"	*4½"	630	50	74	99	124	149	174
	4"	795	39	59	78	98	117	137
	3½"	1040	30	45	60	75	90	105
36-P 3"x6"	*3"	1420	22	33	44	55	66	77
	2¾"	1680	19	28	37	46	56	65
	2½"	2040	15	23	30	38	46	54
	2¼"	2510	13	19	25	31	37	43
H.P. required to secure listed pressures at indicated R. P. M.			22	32	43	54	64	75

*Standard Plunger Size.

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FIGURE 8.—A study of cement cracking, 350 psi tensile, sand and concrete supported.

FIGURE 9.—A study of neat cement rupture, 372 psi tensile, sand supported.

of compaction caused by combustion pressure ranging upward from 150,000 psi.

(b) The compacting effects of gas pressure upon neat cement were particularly noticeable at cement strengths above 36 psi tensile and below about 350 psi tensile. Microscopic examination has shown that in the affected area the granules of cement were moved away from the bullet hole until the minute bubbles of air trapped in the pore spaces were compressed and no longer visible.

The outward appearance of movement was such that it seemed as though the cement had become plastic and flowed under the pressures formed. A section through a compacted area in neat cement indicated the zone of compaction resembled a cone with the apex toward the casing. (Figure 3—Barrels A and B.) This is exactly opposite to the region of cracking in formation, where the base of the cone is at the face between neat cement and formation, and the apex is ahead of the point of greatest bullet penetration.

(c) When neat cement reached a tensile above 335 psi and where loose sand formation existed, there appeared to be less compaction of individual particles; instead, there was increased cracking and rupturing of the cement. Figures 8 and 9 (Barrels 3 and 13) illustrate these results where unconsolidated sand formation was present.

Where substantial backing existed, with concrete formation, the neat cement was better supported, and there was less movement of particles. (Figure 8, Barrel 6.) Generally speaking, in concrete supported barrels there was no cracking of neat cement until the tensile strength was above 245 psi.

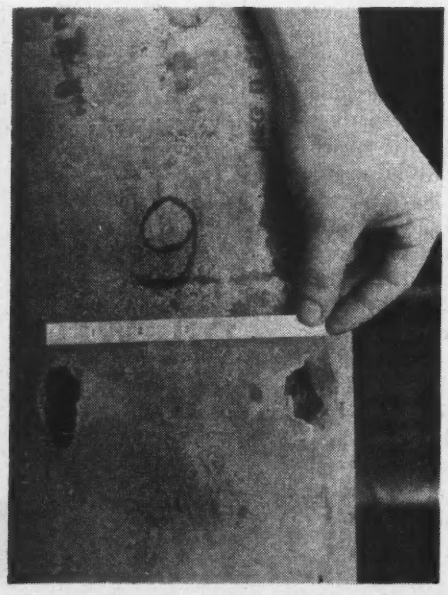

FIGURE 10.—Effect of shot density upon cement cracking, 190 psi tensile, sand supported.

3. It can be said that cement of a given strength (hardness) will shatter more readily and to a greater extent when it is backed up by a soft formation than when it is backed up by a hard formation. In no instance did vertical cracking exceed 18 inches from the bullet hole, regardless of shot density.

The extent of cracking vertically was small under the test conditions. At the present time little is known about subsurface conditions; however, it is believed that cracking will have little effect on field problems. Normally, other conditions such as poor cement jobs, channeling, well depth measurement error, vertical porosity, weakened mud bond to formation face, formation separation, etc., will probably be a greater hazard to overlying or underlying water or gas problems than vertical cracking of neat cement around or alongside casing.

4. A study was made of the effects of shot density upon neat cement. Quite important is the finding that neat cement with a tensile of 180 psi and 190 psi, backed by either sand or concrete formation, did not crack either vertically or hole-to-hole, despite the fact that three shots were placed on the same horizontal plane. (Figure 10 and 11.) (Setting time: 70 to 80 hours surface and roughly 24 hours subsurface.)

With neat cement having a tensile of

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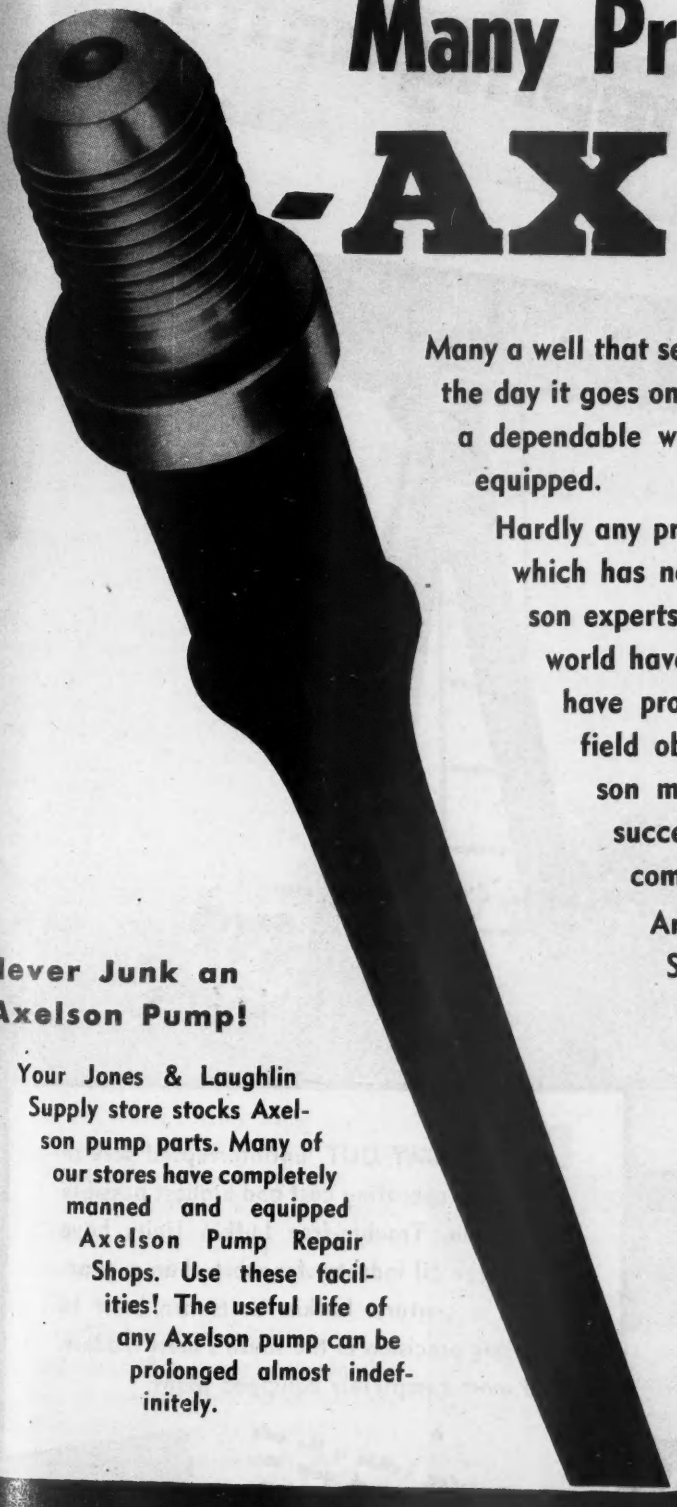

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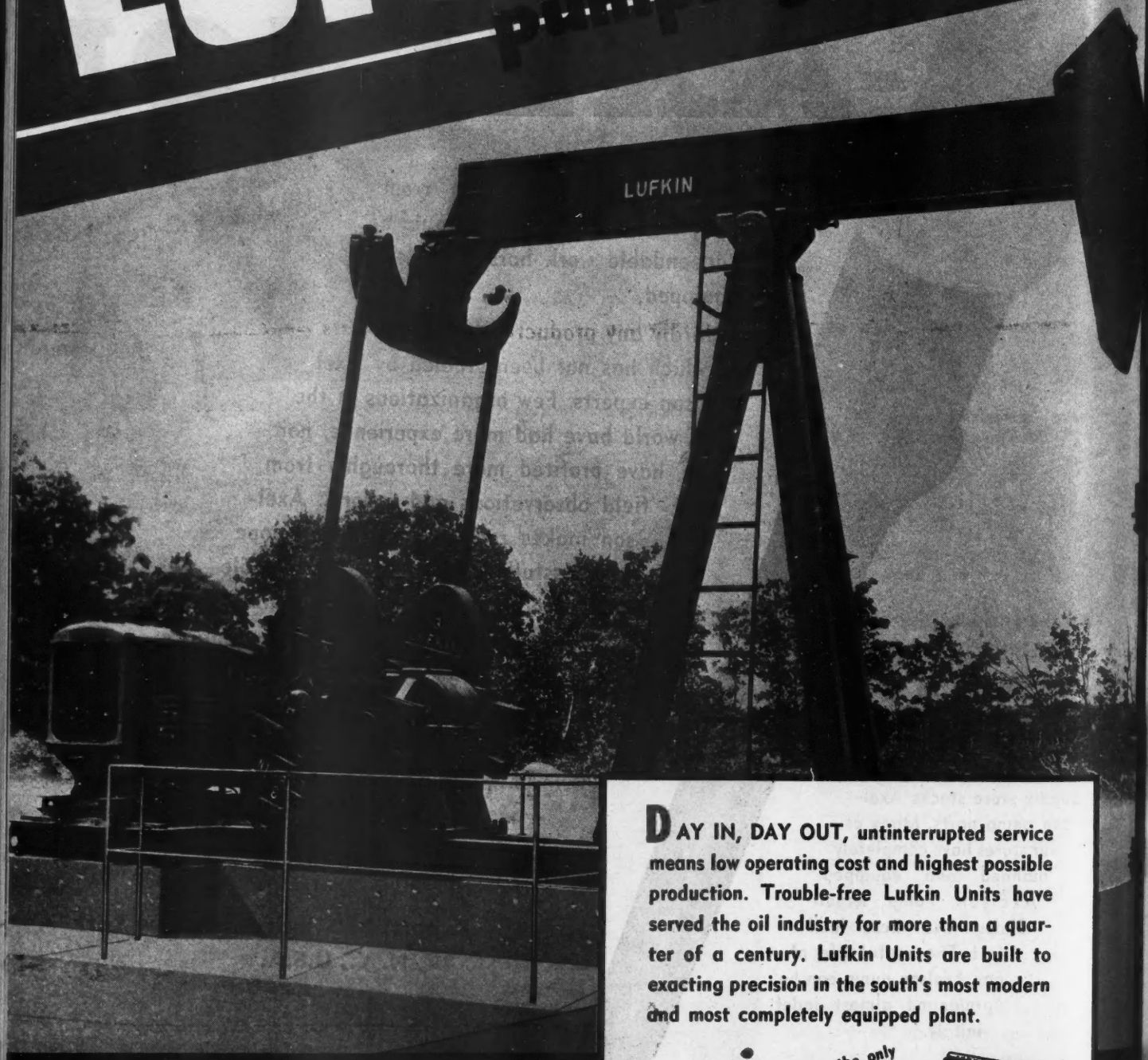

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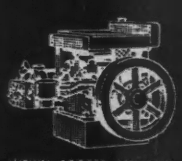

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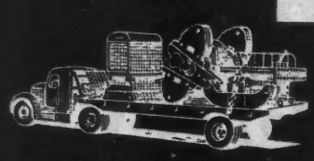

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FIGURE 11.—Effect of shot density upon cement cracking, 180 psi tensile, concrete supported.

307 psi (Barrels 4 and 11, Figure 7), there was hole-to-hole cracking and sunburst cracking. From this point to all stronger neat cements the amount and extent of cracking of neat cement increased. Barrel 13, Figure 9, illustrates the maximum effect which was encountered with cement of 372 psi tensile, sand supported.

THE EFFECT OF GUN PERFORATING ON FORMATION

Test conditions were not initially planned with the intention of determining the amount of cracking occurring in formations of various kinds. For this reason only very hard concrete and very soft unconsolidated sand were studied. A standard test barrel (Figure 1) was used. Concrete formation strength was in excess of 5000 psi in compression, which would probably be as strong as a very dense limestone or sandstone.

Discussion of Results

In general there was considerable cracking of the concrete formation, the area was roughly conical in shape with the base of the cone against the neat cement. Normally this area would increase in depth, as a result of shot density where each succeeding shot would have the benefit of the loosening and jarring caused by preceding shots. Where one shot was fired 90 degrees to 180 degrees around the casing from a preceding shot in air, it did not receive the benefit of the preceding shot. Where shots followed one another, and were reasonably close to each other in air or fluid, the following shots benefit from preceding shots.

In the standard barrel (Figure 1), usually one shot would not crack the concrete a sufficient amount to show on the outer surface of the barrel; yet, increased density (one additional shot in the vicinity) resulted in considerable cracking clearly evident on the outer surface of the concrete.

Generally speaking, this would indicate that where maximum formation cracking or penetration for a given shot density is desired, it could best be accomplished by firing bullets in such manner that each following bullet could receive the benefits of preceding shots.

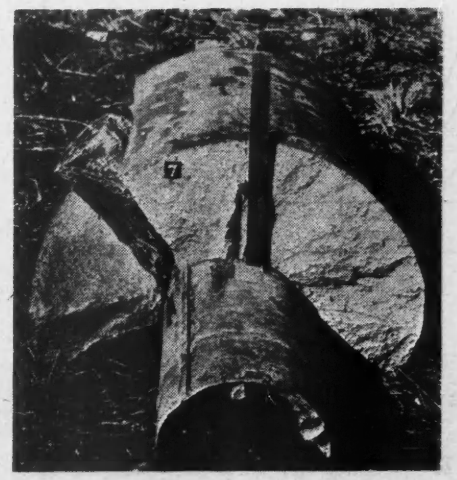

FIGURE 12.—Effect of shot density upon formation.

FIGURE 13.—Effect of adding bentonite to cement, 305 psi tensile, sand supported.

Barrel 7, Figure 12, illustrates the type of fracture resulting from shots placed 90 degrees apart but at different levels. Unfortunately, most of the detail of the small cracks and powdered area is lost in photographing and reproduction.

THE EFFECT OF ADDING BENTONITE TO CEMENT

Bentonite cement, containing six pounds of bentonite per sack of standard Portland cement and 7.25 gallons of water per sack of cement was used between the 5½-inch—17-pound J-55 casing and the 8-inch sheet metal form used in the standard barrel test (Figure 1). The bentonite cement was backed-up with sand formation in the 55 gallon steel drum. Briquette specimens were tested just before shooting the test specimen.

Discussion of Results

General behavior of bentonite-treated cement was the same as standard Portland cement up to strengths of about 300 psi tensile. Above this point, bentonite-treated cement was more resistant to cracking than untreated cement. Figure 8, Barrel 3, illustrates the condition of untreated cement, while Figure 13 illustrates the condition of bentonite-treated cement. The obvious conclusion was that bentonite treatment of cement is conducive to reduced cracking of neat cement behind casing.

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Condensate PRODUCTION AND CYCLING

Part 20

Payout and Cycling Life vs. Permeability

By PARK J. JONES

IN THIS concluding article on condensate production and cycling the compositions of production and cumulative liquid recovery for the three reservoirs of part 19 are considered. A two-year payout relative to a uniform permeability is indicated. The payout relative to an extremely variable permeability, breakthrough of dry gas at the outset of cycling, is about 2.5 years. The cycling life is increased from eight to 12 years. The liquid recovery during 12 years is less than during the eight years of cycling uniformly permeable beds.

Per-Reservoir Production

Let unity represent the per-resevoir displaceable rich gas. Let V_1 denote the total gas production from a reservoir, expressed as a fraction of the displaceable rich gas. Let X_1 and C_1 denote the per-reservoir composition and cumulative liquid recovery respectively. Relative to uniform per-reservoir permeability, we have

$$X_1 = e^{-(V_1 - 0.7)/0.3} \quad (1)$$

and

$$C_1 = 1 - 0.3X_1 \quad (2)$$

for reservoir 1. The corresponding values for reservoir 2 are

$$X_2 = e^{-(V_2 - 0.5)/0.5} \quad (3)$$

and

$$C_2 = 1 - 0.5X_2 \quad (4)$$

Reservoir 3 is produced at the rate of 3 million per day relative to bottom water. Condensation is likely to be negligible for this condition. Accordingly,

$$X_3 = 1 \text{ and } C_3 = V_3 \quad (5)$$

where V_3 is any value between zero and unity. The estimated reserve for displacement by water is 8.26 billion feet or 70 percent of in place rich gas (Table 19-2).

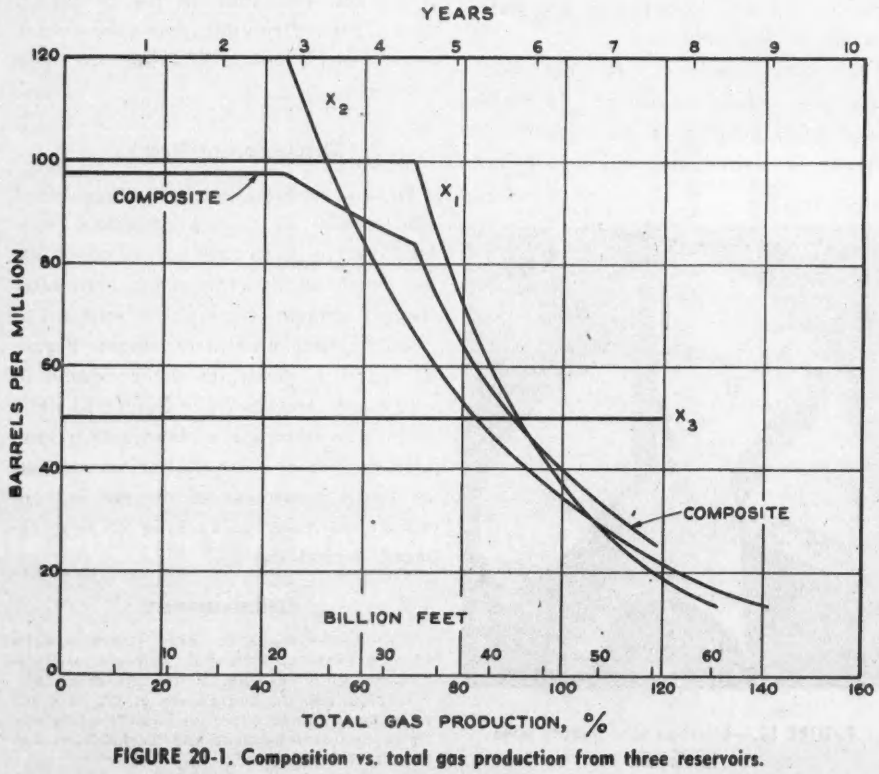


FIGURE 20-1. Composition vs. total gas production from three reservoirs.

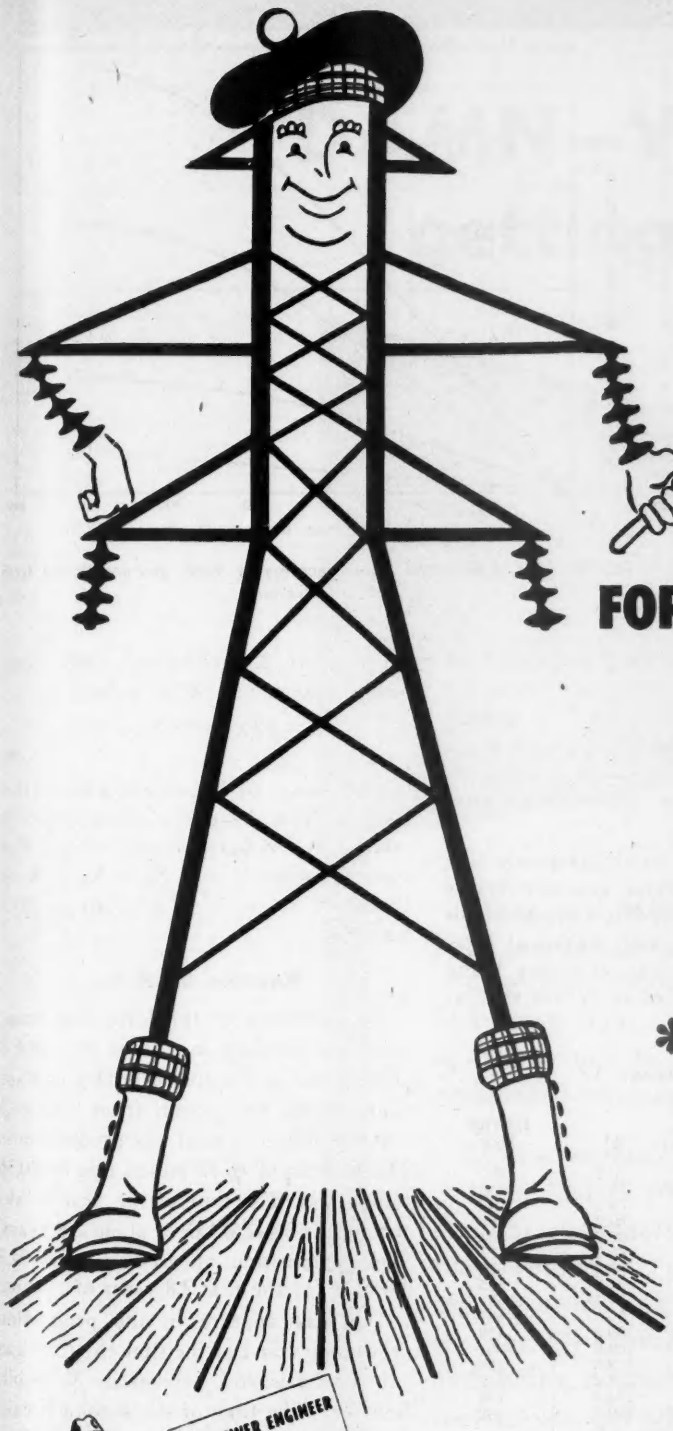
Composite Composition

The total rate of gas production is 20(365) or 7.30 billion feet per year. The rich gas displaceable from the three reservoirs is 46.52 billion feet. So the produced gas V relative to displaceable gas is 7.3/46.52 or 0.157y at the end of y years.

The relationship between total and per reservoir produced gas is defined by

$$V = V_1 \frac{QG_1}{Q_1 \Sigma G_1} \quad (6)$$

where Q is producing rate and G is displaceable rich gas.



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Condensate PRODUCTION AND CYCLING

Part 20

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and

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for reservoir 1. The corresponding values for reservoir 2 are

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and

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$$X_3 = 1 \text{ and } C_3 = V_3 \quad (5)$$

where V_3 is any value between zero and unity. The estimated reserve for displacement by water is 8.26 billion feet or 70 percent of in place rich gas (Table 19-2).

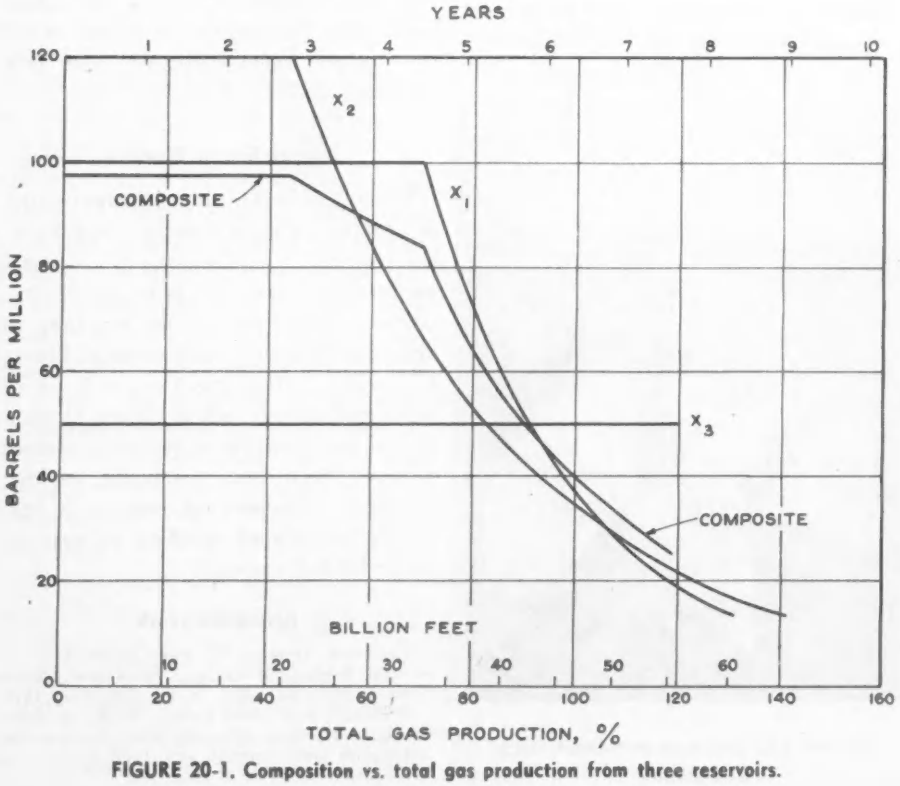


FIGURE 20-1. Composition vs. total gas production from three reservoirs.

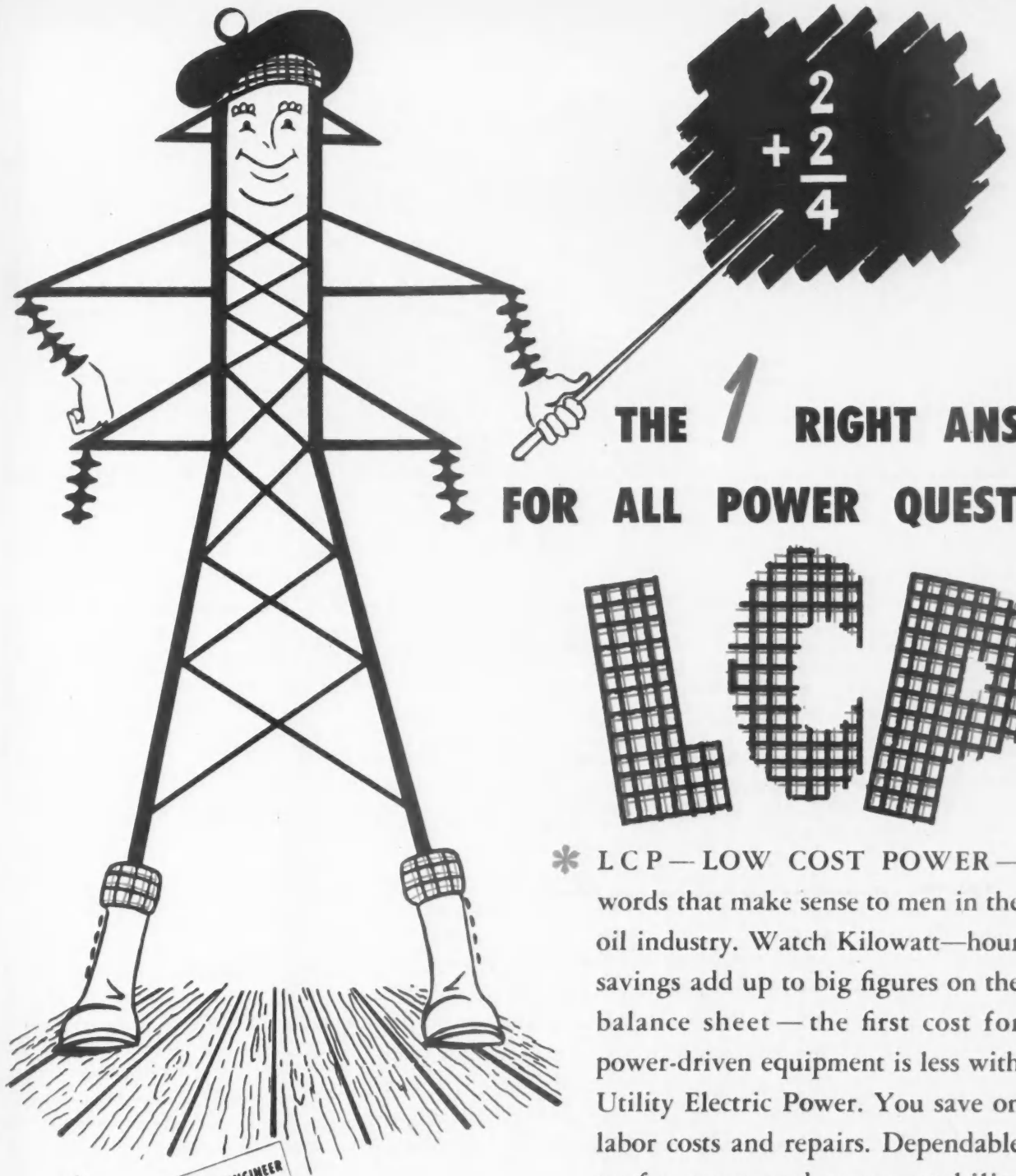
Composite Composition

The total rate of gas production is 20(365) or 7.30 billion feet per year. The rich gas displaceable from the three reservoirs is 46.52 billion feet. So the produced gas V relative to displaceable gas is 7.3/46.52 or 0.157y at the end of y years.

The relationship between total and per reservoir produced gas is defined by

$$V = V_1 \frac{QG_1}{Q_1 \Sigma G_1} \quad (6)$$

where Q is producing rate and G is displaceable rich gas.



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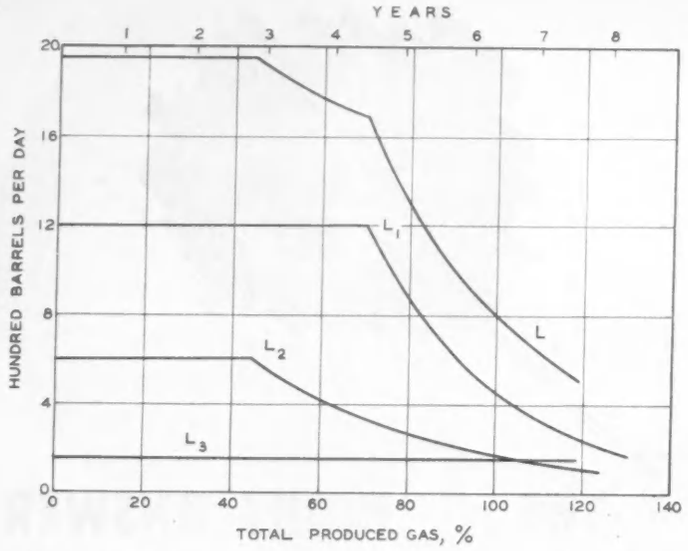

FIGURE 20-2. Liquid producing rate vs. total gas production from three reservoirs.

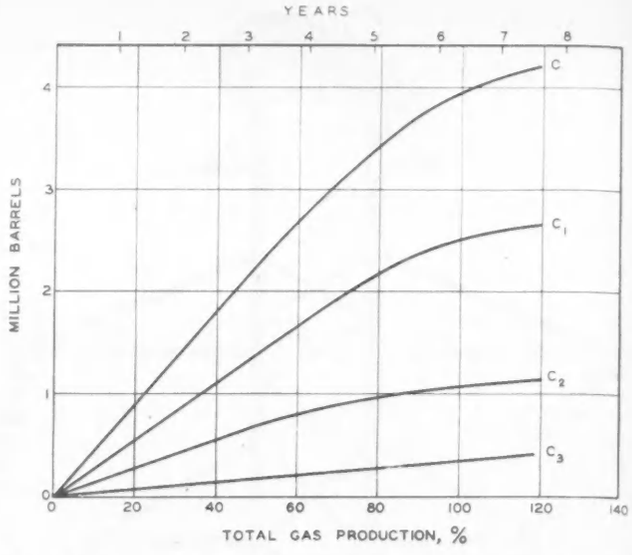

FIGURE 20-3. Cumulative liquid recovery vs. total gas production from three reservoirs.

Application of the foregoing expression to the three reservoirs gives

$$V = 1.003V_1 = 0.883V_2 = 1.184V_3 = 0.157y \quad (7)$$

The life of reservoir 3 at three million barrels per day would be 1.184/0.157 or 7.5 years. Suppose reservoirs 1 and 2 were cycled to their respective economic limits. The corresponding produced gas would be 127 and 154 percent respectively. The estimated life for reservoir 2 is 0.883(1.54)/0.157 or 8.7 years. The reservoir 1 life would be 1.003(1.27)/0.157 or 8.1 years. The composition of the production from reservoirs 1 and 2 after breakthrough requires less makeup gas. So per-reservoir life can be made equal to the life of the project with nominal adjustment of per-reservoir producing rates.

At the time the total gas production is V, the per-reservoir gas recovery is V_1. The corresponding per-reservoir composition is X_1. But the initial composition of the gas in reservoirs 1 and 2 is 2.0 and 2.4 times as rich as the gas in reservoir 3. Accordingly, the composite composition X is defined by

$$X = 1.2X_1 + 0.6X_2 + 0.15 \quad (8)$$

for all values of V not exceeding 118.4 percent. The composite composition is relative to 50 barrels per million. For instance, when $V = 0$, $X_1 = X_2 = X_3 = 1$ and $X = 1.95$ or 1.95(50) or 97.5 BPMM.

Table 20-1—Composition and Recovery from Reservoir 1

%V_1	A_1*	%X_1& BPMM	%C_1	Million Barrels	%V	Barrels Day
70	.....	100	70.0	1.959	70.2	1200
73	.1	90.5	72.8	2.038	73.2	1086
76	.2	81.9	75.4	2.110	76.2	983
79	.3	74.1	77.8	2.178	79.2	889
82	.4	67.0	79.9	2.236	82.2	804
85	.5	60.6	81.8	2.290	85.3	727
88	.6	54.9	83.5	2.337	88.3	659
91	.7	49.6	85.1	2.382	91.3	595
94	.8	44.9	86.5	2.421	84.3	539
97	.9	40.6	87.8	2.458	97.3	487
100	1.0	36.8	89.0	2.491	100.3	442
106	1.2	30.1	91.0	2.547	106.3	361
112	1.4	24.7	92.6	2.592	112.3	296
118	1.6	20.2	93.9	2.628	118.4	242
124	1.8	16.5	95.0	2.659	124.4	198
130	2.0	13.5	95.9	2.684	130.4	162

* $A_1 = (V_1 - 70)/30$.

Table 20-2—Composition and Recovery from Reservoir 2

%V_2	A_2*	%X_2	BPMM	%C_2	Million Barrels	%V	Barrels Day
50	.....	100	120	50.0	0.616	44.2	600
55	.1	90.5	108.6	54.7	.674	48.6	543
60	.2	81.9	98.3	58.0	.715	53.0	492
65	.3	74.1	88.9	62.9	.775	57.4	444
70	.4	67.0	80.4	66.5	.819	61.8	402
75	.5	60.6	72.7	69.7	.859	66.2	364
80	.6	54.9	65.9	72.5	.893	70.6	330
85	.7	49.6	59.5	75.2	.926	75.1	298
90	.8	44.9	53.9	77.5	.955	79.5	270
95	.9	40.6	48.7	79.7	.982	83.9	244
100	1.0	36.8	44.2	81.6	1.005	88.3	221
110	1.2	30.1	36.1	84.9	1.046	97.1	180
120	1.4	24.7	29.6	87.6	1.079	106.0	148
130	1.6	20.2	24.2	90.9	1.120	114.8	121
140	1.8	16.5	19.8	91.7	1.130	123.6	99
150	2.0	13.5	16.2	93.2	1.148	132.5	81
160	2.2	11.1	13.3	94.4	1.163	141.3	66

*$A_2 = (V_2 - 50)/50$

Equation Solutions

The solutions of the foregoing equations are itemized in Tables 20-1 and 2 and plotted in Figure 20-1. Dry gas appears in the production from reservoir 2 at the time the total gas production is 44.2 percent of 46.52 billion feet or 20.56 billion feet. The time of the first breakthrough is 0.442/0.157 or about 2.8 years. The composition of production is 97.5 BPMM for the first 2.8 years of cycling.

Dry gas appears in the production from reservoir 1 at the time the total gas production is 70.2 percent or 32.66 billion feet. The time of the second breakthrough is 0.702/0.157 or 4.5 years. The composition of production is 50 [1.2 + 0.6(0.55) + 0.15] or 84.0 BPMM.

The estimated breakthrough of water into the well producing from reservoir 3 is at 118.4 percent total gas production. The corresponding time is 7.5 years, $X_1 = 0.2$ and $X_2 = 0.19$. The estimated composite composition is 25.2 barrels per million. This procedure gives the composite composition curve shown in Figure 20-1.

Liquid Recovery

The liquid producing rate L equals the sum of the per-reservoir products of

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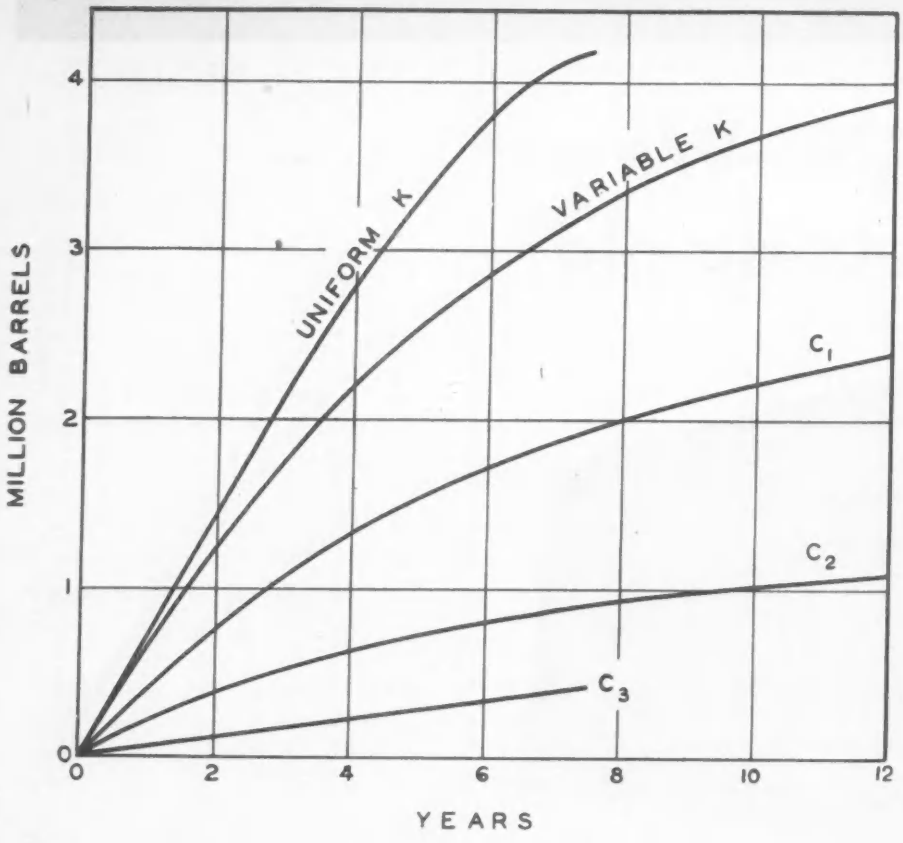

FIGURE 20-4. Comparison of minimum liquid recovery for extremely variable permeability with the probable liquid recovery if permeability were uniform in reservoirs 1 and 2; and C curves are per-reservoir liquid recovery.

gas producing rate and composition. Thus

$$L = 12X_1 + 5X_2 + 150 \qquad (9)$$

where the X's are the per-reservoir compositions in barrels per million.

At breakthrough in reservoir 2, $X_1 = 100$, $X_2 = 120$, and the liquid producing rate is 1950 barrels per day. A breakthrough in reservoir 1, $X_1 = 100$, $X_2 = 66$, and the liquid producing rate is 1680 barrels per day. At breakthrough of water in reservoir 3, $X_1 = 20$, $X_2 = 22.8$, and the liquid producing rate is 504 barrels per day. This procedure gives the curves shown in Figure 20-2.

Cumulative liquid recovery from reservoir 3 is proportional to the gas production from that reservoir and is defined by V/1.184 times 0.413 the displaceable liquid. Hence, C_3 in million barrels is given by

$$C_3 = 0.3488V \qquad (10)$$

Cumulative liquid recoveries from reservoirs 1 and 2 are itemized in Tables 20-1 and 2 and plotted in Figure 20-3. The sum of the per-reservoir data gives the cumulative liquid recovery for the project.

The Payout

The investment for seven wells at $100,000 per well would be $700,000. Plant investment at $40,000 per million daily capacity would be $800,000 or a total of $1,500,000, including interest during payout.

The initial uniform liquid producing rate is 1950 barrels per day or 711,700 barrels per year. Let the sum of taxes, royalty, and cycling expenses be 40 percent of gross liquid production. Then the annual income at $1.80 per barrel would be 711,700(0.6)(1.8) or $768,600 per year. The project would pay out in about two years.

The time of the first breakthrough is 2.8 years relative to uniform permeability. Hence, payout would be prior to breakthrough provided the permeability in reservoir 2 were uniform. But a reservoir is not likely to have a uniform permeability. Gas is likely to breakthrough via the interval having the highest permeability. The per-interval producing rates for small reservoirs are not controllable. Pay intervals are too thin to permit selective completion of wells even if there were sufficient data to map out permeability ratios. Consequently, there should be an ample spread between the life and payout of small cycling projects for which breakthrough is based on uniform permeability.

The location of injection and producing wells fixes the breakthrough area for a given reservoir, for instance, the 70 and 50 percents for reservoirs 1 and 2. If the ratio of permeabilities as between beds were unity, well locations would also fix the invadable acre-feet of pay. The latter fixes the displaceable liquid aside from economic limits and condensation.

For variable permeability as between intervals, the breakthrough recovery is numerically less than the breakthrough area fixed by well locations. That is, the acre-feet of pay in the most permeable interval is less than the invadable acre-feet of pay.

Suppose injection and producing wells were interconnected via a very thin bed for which the permeability were very high by comparison with the permeability of the other beds in which wells are completed. In effect, the wells would be interconnected via a pipeline through which dry gas could reach producing wells at the outset of cycling operations. In addition, let a reservoir have a wide range of permeability ratios. Under these most adverse conditions, the probable composition of production is not less than the composition defined by a zero breakthrough. The corresponding composition X and cumulative liquid recovery C at any time y years and annual gas producing rate Q are defined by

$$X = e^{-yQ} \text{ and } C = 1 - e^{-yQ}$$

Payout and Cycling Life

The C_1 curves in Figure 20-4 are the minimum cumulative per-reservoir liquid recoveries. The sum of the per-reservoir recoveries gives the minimum cumulative liquid recovery for extremely variable permeability. The curve denoted by uniform K is for uniform permeability.

The payout for uniform permeability was 2.0 years. The payout for extremely variable K is about 2.5 years. However, if the payout relative to uniform permeability had been, say, four years, the corresponding payout relative to extremely variable permeability would have been more than six years. This illustrates the influence of dry gas in production on payout.

The other effect of variable permeability is to prolong the cycling life of a project. In the above example, the cycling life is increased from eight to twelve years. Lastly, liquid recovery is 4.16 million barrels at the end of eight years for uniform permeability and about 3.90 million barrels at the end of 12 years relative to a zero breakthrough.

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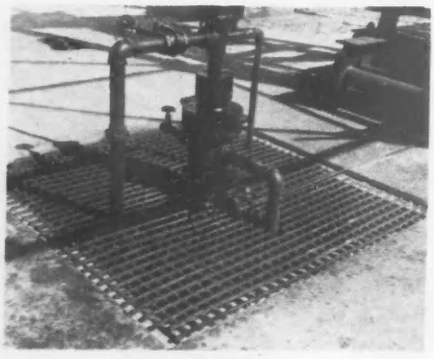
HOW TO—Use Scrap Sucker Rods to Make Grilled Cellar Cover

A cellar cover which permits waste oil to drain without making the area hazardous is made up from scrap five-eighths-inch sucker rod, welded with the rods spaced on 2½-inch centers. The bottom half of the grille is tacked to planks at the desired spacing, and the upper half laid across the spaced rods and each junction tack welded. After the grille is made up to the dimensions of the center opening in the concrete apron of the well, it is cut apart with the torch along the line of the Christmas tree and flow lines and notches cut to accommodate the lines which are set at right angles to the first cut. Clearance is made for the lines by cutting away one or more rods, as needed.

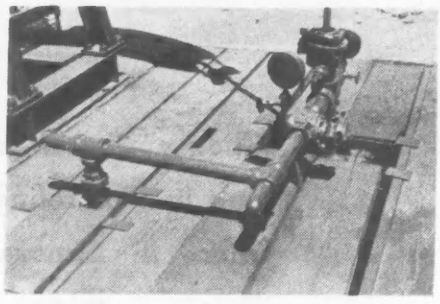


The welded grille is heavy enough to be used as footing when the well is serviced, the closely spaced rods giving a good grip for the shoe soles. When the grille is coated with paraffin and oil, it may be removed from the cellar opening and cleaned by putting it into a fire momentarily, removing it before the rods can become heated enough to lose their shape and strength.

The grille is retained by the shoulder of the recess formed in the concrete apron, and requires no other fastening to insure its remaining in place.

HOW TO—Provide Solid Support for Short Planks on Well Cellar Floor

A common hazard is the failure on the part of field crews to provide a means of solidly supporting the short planks in the center of the cellar floor. These center planks, having to be cut in half where they abut the wellhead, often are supported in the center by makeshift methods and may give away if a heavy person or object stands on them. One of the simplest yet most effective supports that can be made consists of two lengths of 2½- or three-inch angle iron which are cut and welded in such a way as to form floor-level, sturdy supports for the short planks, the latter being cut to a length which will allow them to fit exactly between the cellar edge and the supporting brackets.



The broad ears of the brackets are supported on either side by adjoining full length planks. Brackets of one- and two-plank width are made in quantities in the shop and brought out to the field when needed. Little time is consumed in the field other than cutting of the short planks to the exact length required for the particular well. Practically any well can be equipped with this method of plank support. The principal precaution is in seeing that adjoining full length planks are sufficiently strong and straight that the brackets will be supported and held in place satisfactorily.

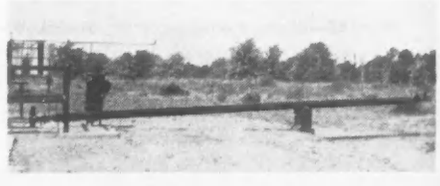
HOW TO—Construct Accumulator to Store Gas for Auxiliary Purposes

In fields where but little gas is produced with the oil, some method for powering the chemical feeder on flowing wells is required. One producer utilizes gas collected in the casing annulus for this purpose, storing it in an accumulator which is tied into the bleeder valve.

The accumulator consists of a joint of six-inch pipe, supported at a slight angle so that any liquid produced with the gas will drain back into the casing. The accumulator is charged by cracking the bleeder valve and permitting the unit to fill with gas until pressure is equalized with the casing. The bleeder valve is then closed, retaining the charge in the "bottle" until used.

A ⅛-inch copper line is connected to the chemical feeder mechanism through a regulator so that the device will operate until the charge of gas stored in the chamber is exhausted. With such a hook-up, the feed of chemical into the production flow line can be started before the flow of crude, so as to insure chemical treatment of all oil produced.

By charging the bottle at night, advantage is taken of the expansion of the trapped gas when the accumulator is heated by the sun during the daytime well-flowing period. Absorption of heat is boosted by painting the accumulator black.



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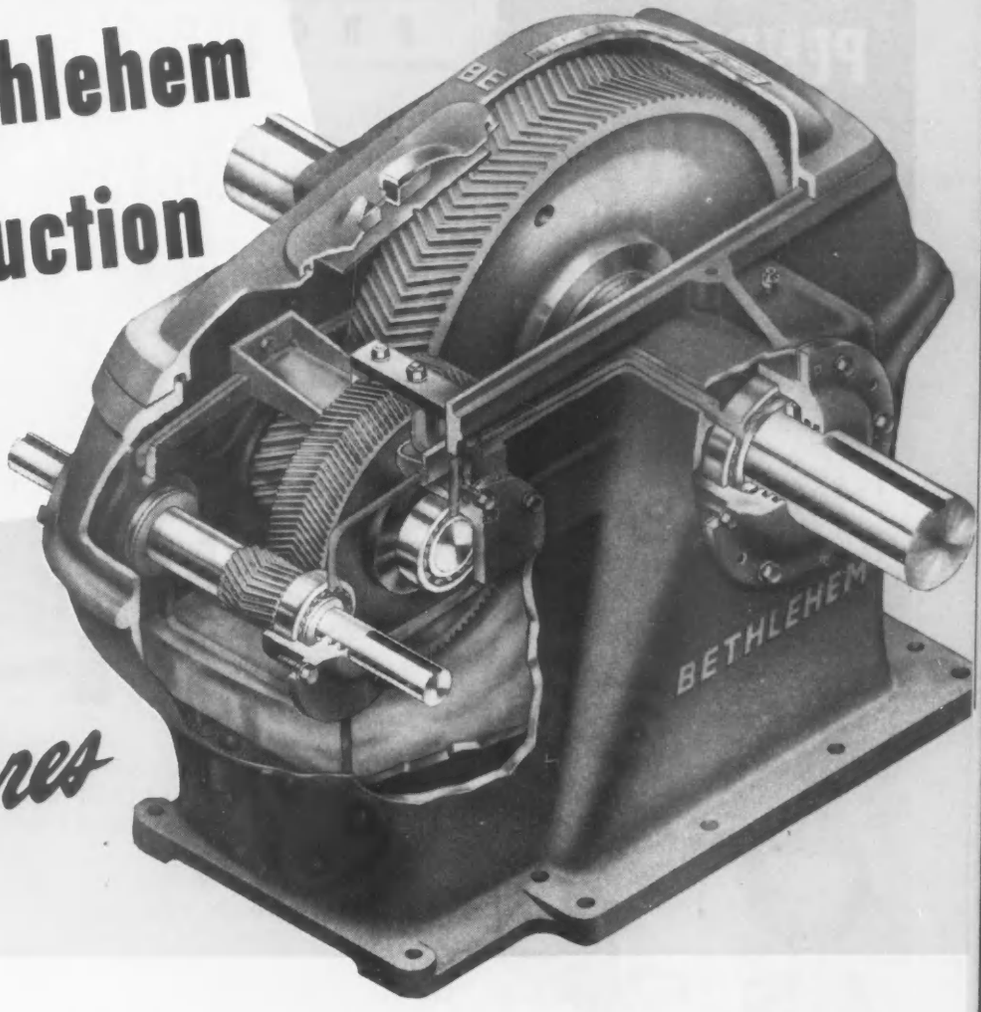

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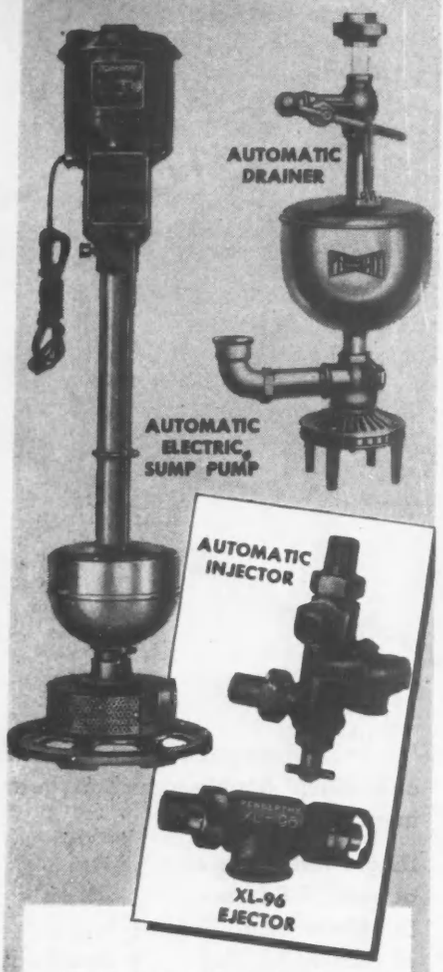

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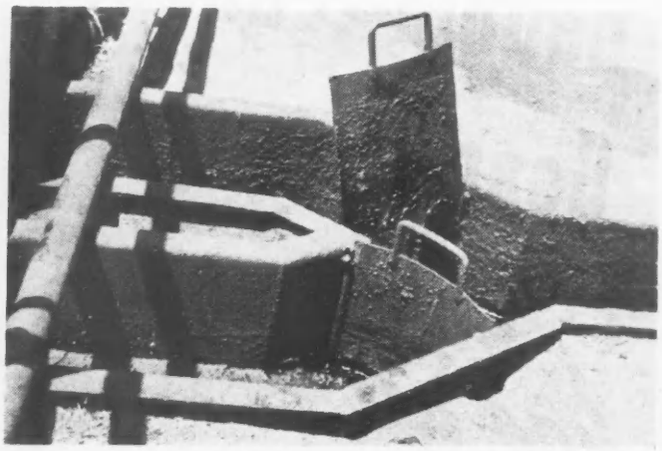
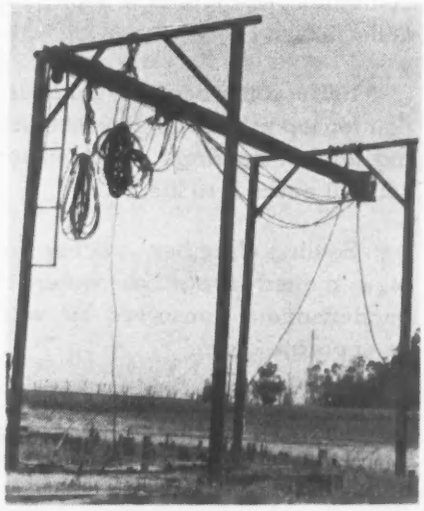
HOW TO—Control Flow from Tank Bottoms



The type of fluid withdrawn from stock tanks determines its disposition: if mostly water, the bottoms can be diverted to the proper skimmer; if mostly oil, it can be diverted to a separate pit or tank. To make it much easier for the pumper or man in charge of cleaning tanks to divert the bottoms according to the type of withdrawal the flume that carries the bottoms to the disposal vats or pits can be branched and fitted with slip gates which are easily opened or closed as the case may be.

The flume itself is all steel with the side members topped with angle iron to eliminate sharp edges. Where it branches to lead to separate pits, the division is made by constructing the center panels with a sharp edge. Near the point of the center section, and on either side of the opposite panels, guides are welded as retainers for the flume gates, which are made of sheet metal and shaped to conform to the flume. Wide bails are welded to the uper end of the gates so they may be withdrawn or placed in position quickly and easily.

HOW TO—Store Mobile Service Unit Mast



When a mobile well service unit is to be used alternately on wells having derricks and again on wells from which the derrick has been removed, the self-contained mast is not necessary at the derrick equipped well. When a well without a derrick is to be pulled, the mast again is needed, so one producer equips the unit with a mast which can be dismounted.

To make it easy for the service crew to mount or dismount the mast, an aerial storage rack is constructed in which to hang the mast when it is not needed. This rack is made with two pairs of tall vertical posts connected across the top with heavy pipe substantial enough to support the weight of the mast easily. When the mast is to be removed, the mobile unit is driven into the area to a point where the ends of the mast match the cross members. A sheave is attached first to one cross member and then at the other so each end of the mast may be raised independently. When the top of the mast, for example, is raised, it is secured in position with a looped chain and locked. Then the base of the mast is raised in the same manner with the sheaves and service wire lines attached. Hoisting is done with a winch. To lower into place on the unit, the operation is reversed.

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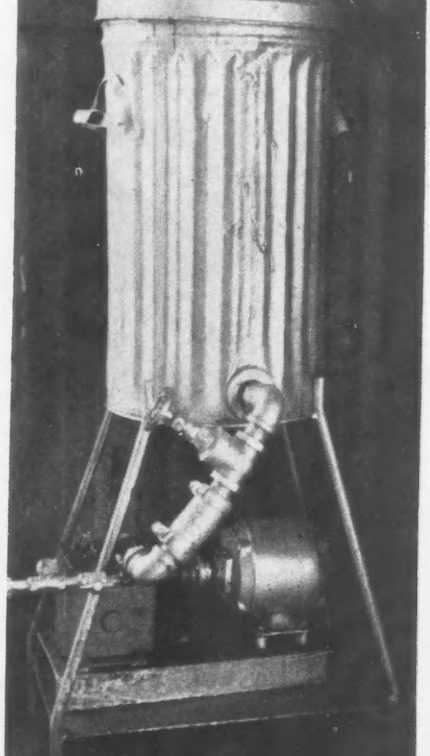
Build Portable Feeder

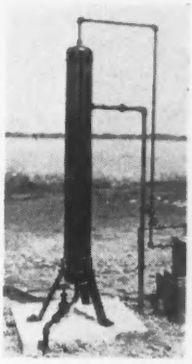
A completely portable chemical feeder can be used on leases and on small tank farms. The pump is the conventional electric motor driven unit mounted on a section of channel iron which acts as the base for the unit. A stand is made from four pieces of round steel (salvaged sucker rods) which form the legs and have a flat plate near the bottom upon which the pump unit is installed. The legs taper inwards toward the top where a round sheet of steel is welded as a support for the reserve and feed tank for the chemical used to treat the cut oil.



The tank is a common garbage container with a one-inch flange brazed in the side near the bottom to which is connected the lead line carrying the chemical directly to the pump. The unit can easily be set in one corner of the building housing the oil gathering pump with the service cord plugged into a convenient outlet in the building. The feed line from the pump is carried in the conventional manner to the pump manifold for introducing the treating chemical into the oil for breaking the emulsion.

HOW TO—

Construct Gas Scrubber For Chemical Feed Pump



The gas that is used to power the chemical feed pump at a tank battery is exhausted inside the unit where the moving parts operate in a bath of oil. If salt water or other moisture in the gas were discharged along with the gas, it is likely that the pump would soon rust.

To insure the delivery of clean, moisture-free gas to the chemical pump, an efficient gas scrubber that also serves as a volume chamber was designed and installed. The scrubber consists of a four-foot section of six-inch casing that has been mounted in an upright position by three strap-steel legs as shown. Each leg was welded to the chamber and bolted to a concrete foundation especially provided for the unit.

Three connections are provided. The gas inlet through one-inch pipe connections is located near the top of the unit. Gas is furnished by the lease separator. Dry gas is discharged through a ½-inch line at the top of the scrubber from which the gas goes to the chemical feeder pump. A one-inch line welded to the bottom of the scrubber and equipped with a globe valve provides a drain for any liquids that are separated from the gas. This drain line discharges into the burning pit located a safe distance from the lease tank battery. Such a system provides a dependable, efficient method of cleaning the gas that powers the chemical feeder pump, thereby assuring continuous operation with a minimum of maintenance.

HOW TO—

Mount Valves for Compact Manifold

Where one tank battery receives production from ten or 12 wells, common practice is to manifold the flow lines so that the production from each well can be directed either into the test separator or into the lease separator. Such a manifold system involving this number of

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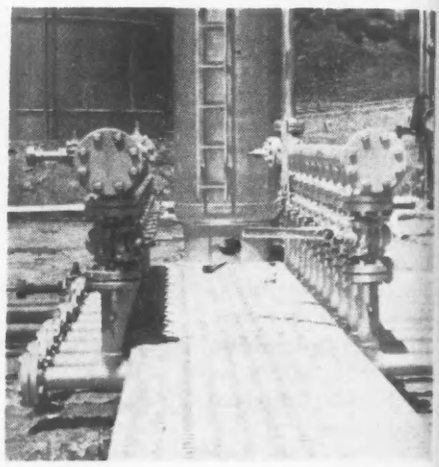
well flow lines would be a strung-out design unless the valves can be mounted as illustrated.

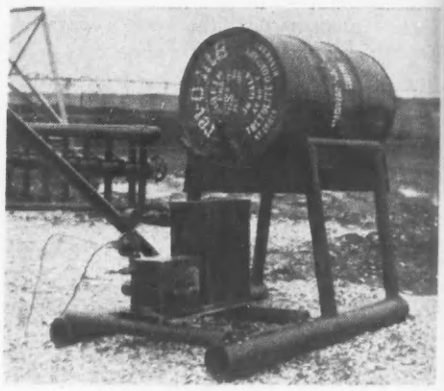
A neat and efficient lease manifold which controls the flow of oil from eleven wells is shown. A dual set of valves were tied into the flow line so each well could be flowed into the test separator or the lease separator. An expanded metal walkway was constructed between the battery of valves for the convenience of the pumper in charge of the lease. It was possible to mount the valves closely together by setting them at a 45 degree angle with the manifold line. In this position, it is possible to close or open any of the valves without striking an adjacent line which would otherwise hinder operating the valve. Since all valves are of the plug type and have been standardized on this particular installation, only one valve stem handle was required for each bank of valves.



HOW TO—Unitize Chemical Treating Equipment

Where chemical is used on flowing leases to break down emulsions, a handy rack may be made which holds the chemical pump and supply tank as well as the chemical drum. As shown, the rack is made from four-inch and two-inch scrap pipe. The chemical pump is fastened to the two lower two-inch cross members and the chemical drum is conveniently placed on a rack above so that the chemical will gravitate from the drum into the supply tank.

The entire assembly is placed near the entrance into the tank battery so that the pumper can inspect it each time he passes through the gate. Gas supply to the pump is conveyed by copper tubing to a pipe which lays underground, and the chemical outlet is also piped from this convenient place to the header from the various wells on the lease.



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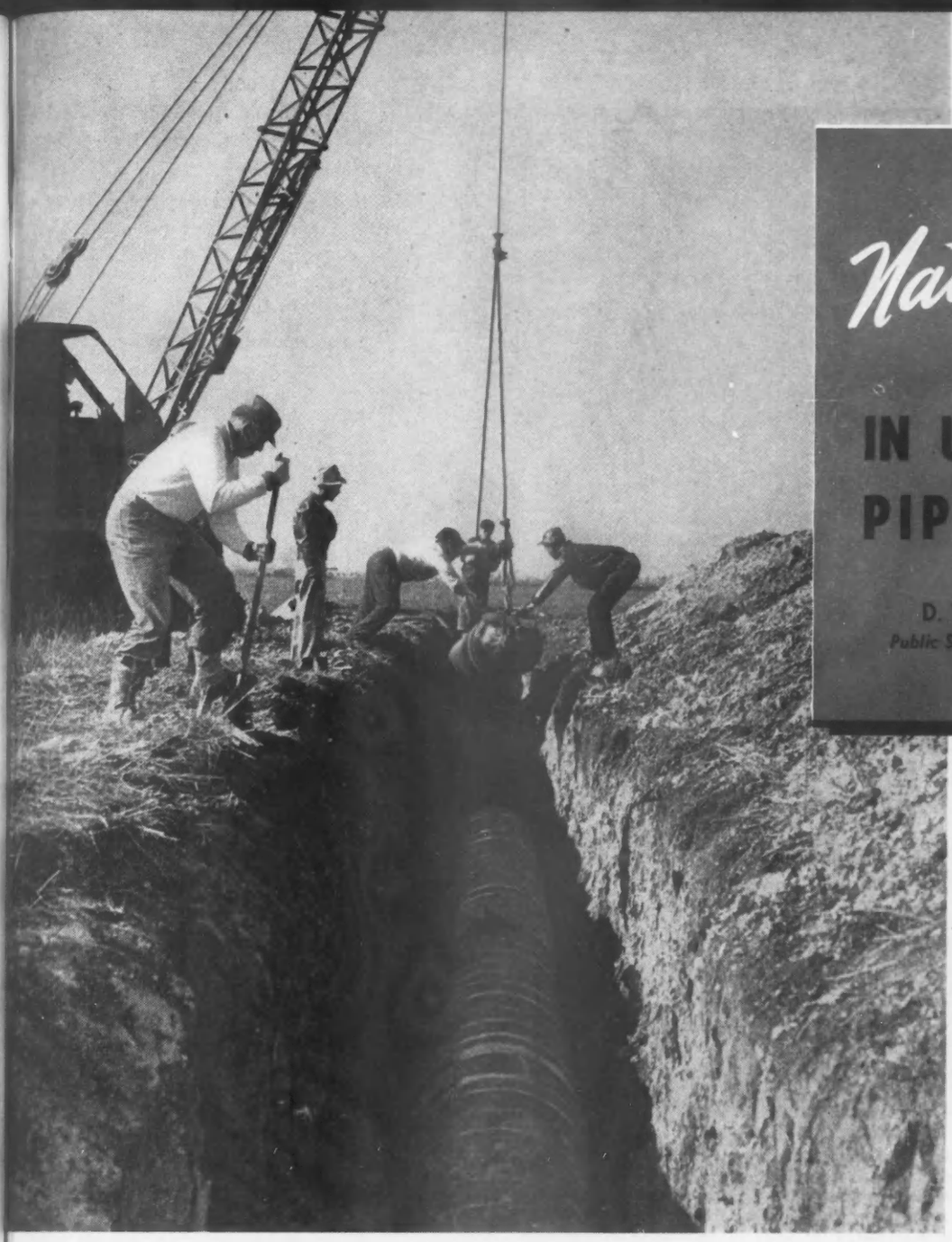


Natural Gas Storage IN UNDERGROUND PIPE SECTIONS

By
D. V. Meiller, *Staff Engineer*
Public Service Company of Northern Illinois

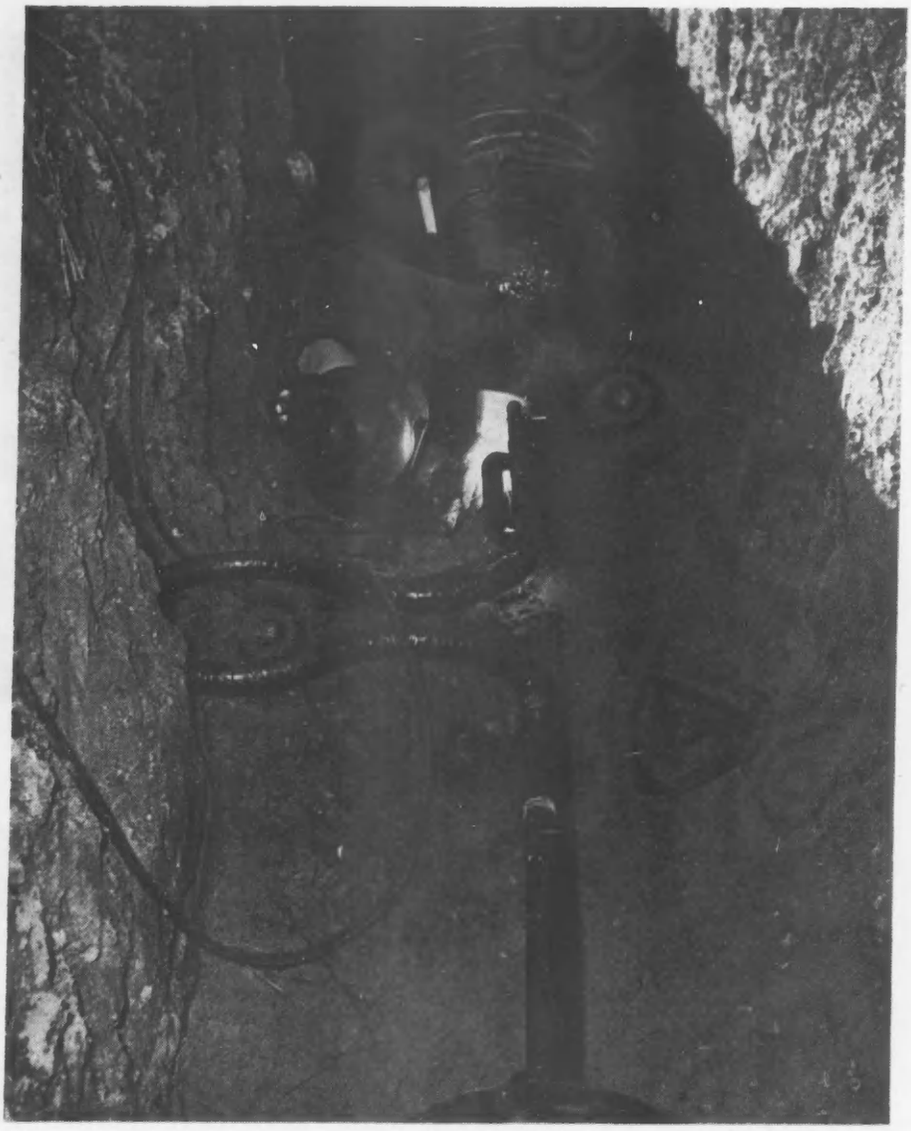
Individual pipe section, each of which weighs about 5000 pounds, being lowered into 3-foot wide trench. Special gauge was used to assure proper end to end spacing between pipe sections. This permitted installation of the expansion bends without field cutting or bending, and without further moving of the pipe sections.

WITH expansion of natural gas markets and the development of long distance, large diameter, thin wall, steel gas pipe lines of high capacity, many of the gas companies which formerly distributed manufactured gas changed over to natural gas or to a mixture of natural gas and manufactured gas. The economics of distributing natural gas for these companies was different than for the firms which started out with the distribution of natural gas from nearby fields. As the loads of these companies grow and exceed the capacity of the supplying pipe lines, the installation of additional pipe line capacity is more difficult from financial and physical aspects than in the case of companies close to the source of supply.

Large capacity, long distance pipe lines are in general very reliable facilities. However, no matter how capable or diligent the operators of such lines may be, there is always the possibility of a break in such pipe lines from causes beyond the control of the operators, with resultant temporary interruption of gas deliveries, either total or partial, to the ultimate distributor. Some utility companies served by long distance pipe lines are fortunate in having depelted gas fields near at hand in which they can store gas during the summer, and from which the gas can be later withdrawn and used for peak loads or in cases of emergency. However, certain areas are not in this fortunate category. Where gas manufacturing facilities are not available, or where gas manufacturing capacity is insufficient to carry the load in an emergency, it is desirable to store gas locally in quantities predetermined by the excess of the load over the capacity of the gas manufacturing facilities.

Pioneered less than two years ago, underground, high-pressure storage of natural gas now utilizes upwards of 100 million cubic feet at pressures around 2240 pounds per square inch. Compressibility factor and minimum temperature range contribute appreciably to effectiveness of this type of storage, in which around 30 miles of 24-inch, thick-walled pipe is used. The author describes the initial installations and evaluates the method against other means for shaving gas pipe line peak requirements.

In 1947 the Public Service Company of Northern Illinois converted its Northern Operating Division from 800 British thermal units mixed gas operation to natural gas operation. The load, which is



Pipe sections were connected by expansion bends made from 1½-inch extra heavy seamless Grade A pipe. In the picture the expansion bend is being electrically welded into the adapter. As each one million cubic-foot section was completed it was pressured to 2350 pounds with gas. As gas cooled to ground temperature, usually within a few hours, pressure would drop to about 2240 pounds. All joints, both welded and threaded, were then tested for leaks by covering them with water. After inspection, the connections were covered with sand and the ditch backfilled.

predominantly residential, has grown very rapidly in this area north and northwest of Chicago. Of the 50,000 customers served in this area about 12,500 are using gas for space heating. This space heating load has resulted in a very high peak load on cold days, thereby making more difficult the problem of storing gas in sufficient quantities to afford the desired system protection. Recognizing the desirability of some type of natural gas storage for this and similar situations, the Public Service Company undertook a research program to determine the most feasible method of natural gas storage. Some of the methods considered were as follows:

1. Conventional low pressure gas holders.

2. Conventional high pressure gas holders above ground, with pressures in the order of 60 to 100 pounds.

3. Storage of natural gas in the liquid state at low temperatures and substantially atmospheric pressure.

4. Natural gas absorbed in propane, either at low temperatures and nominal pressures, or at normal temperatures and high pressures.

5. Other methods, among which are absorption, and in hydrate form.

6. Gas stored at high pressure in buried pipe.

Requirements for Storage

Some of the requirements for storage were:

1. It should be safe.

2. It should be reliable.

3. It should be subject to quick installation.

4. It should have a low operating cost.

5. Investment required should be reasonable.

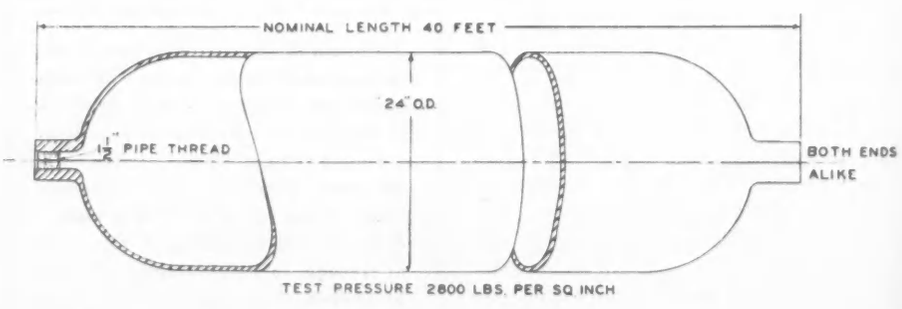
6. It should not be unduly complex in design or operation.

After considering the various methods, it was decided that storage at high pressures in buried pipe was best suited to our particular problem and requirements. Accordingly, in 1946, the company designed and installed near Kankakee, Ill., a natural gas storage field of this type, which stores 1.25 million cubic feet of natural gas. This field served as a pilot plant.

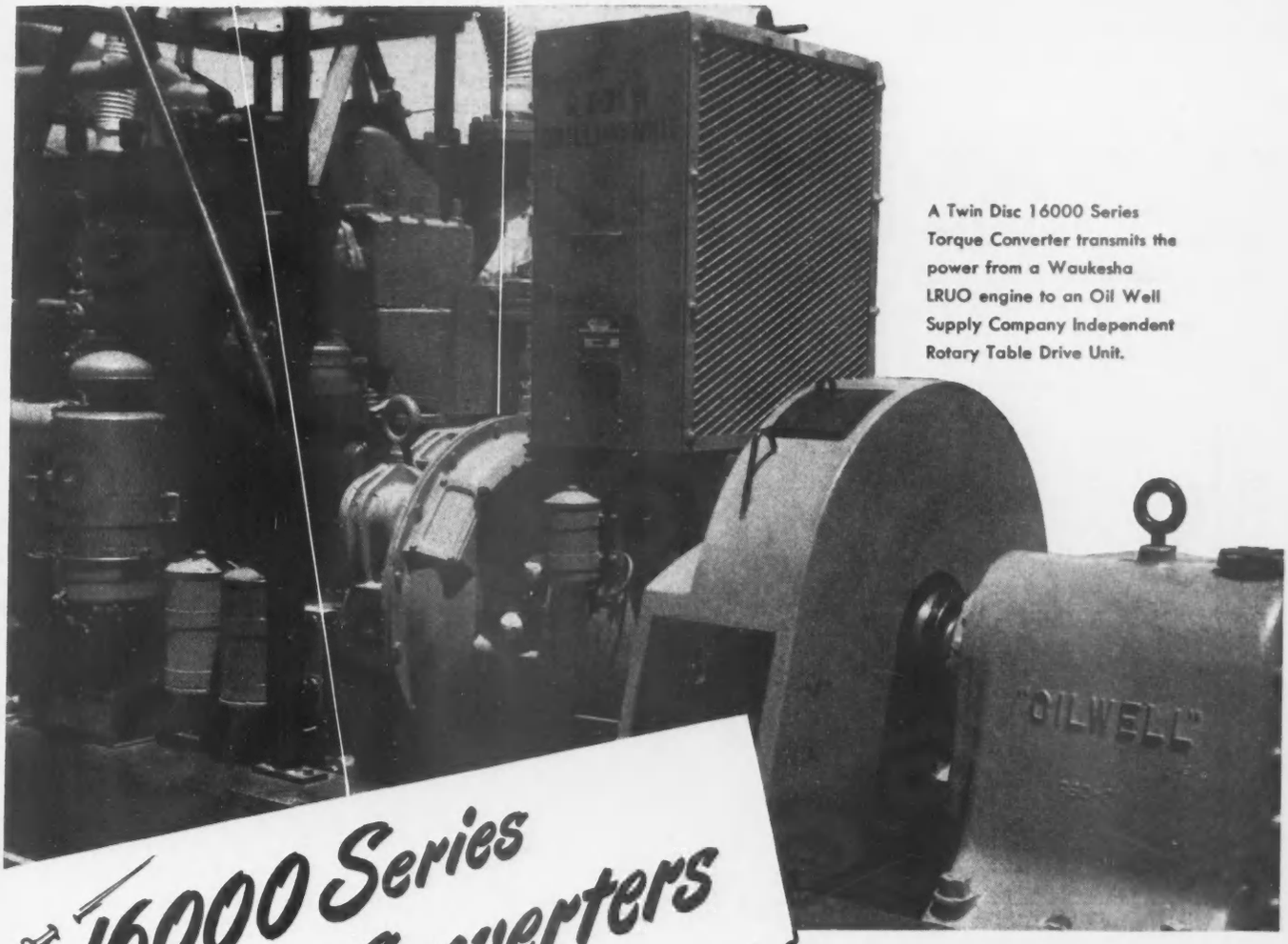
This new type of natural gas storage consists of buried random lengths of 24-inch outside diameter seamless, high carbon, alloy steel pipe, the average length being about 40 feet.

To avoid field welding of this high carbon pipe, both ends of each length of pipe are swaged down and tapped for 1½-inch pipe thread.

Many of the costs entering into this type of gas storage, such as the cost of trenching, coating, laying, cathodic protection, land, etc., are independent of the operating pressure; therefore, a high operating pressure obviously results in lower costs per unit of gas stored. The operating pressure selected was 2240 pounds per square inch, at which pres-



Diagrammatic drawing of typical natural gas underground storage pipe section. As the sketch indicates the pipe sections are 24-inch O.D., and about 40 feet long. Each section will hold 25,000 cubic feet of gas at 2240 pounds per square inch. Since this quantity of gas weighs well over half a ton the gas stored in each section weighs in excess of 20 percent of the weight used in the pipe sections.



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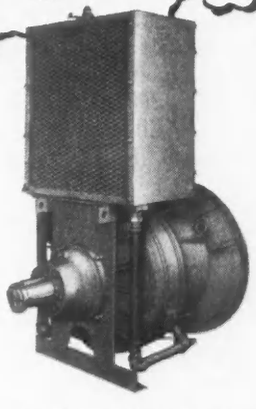

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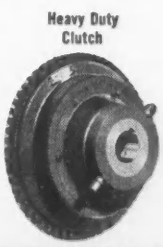

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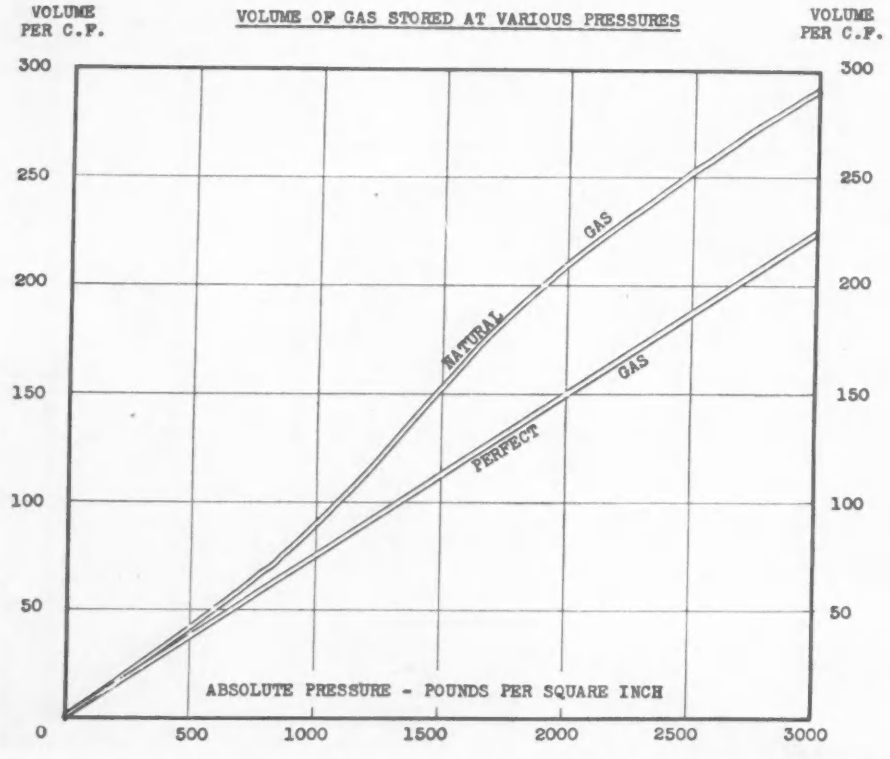
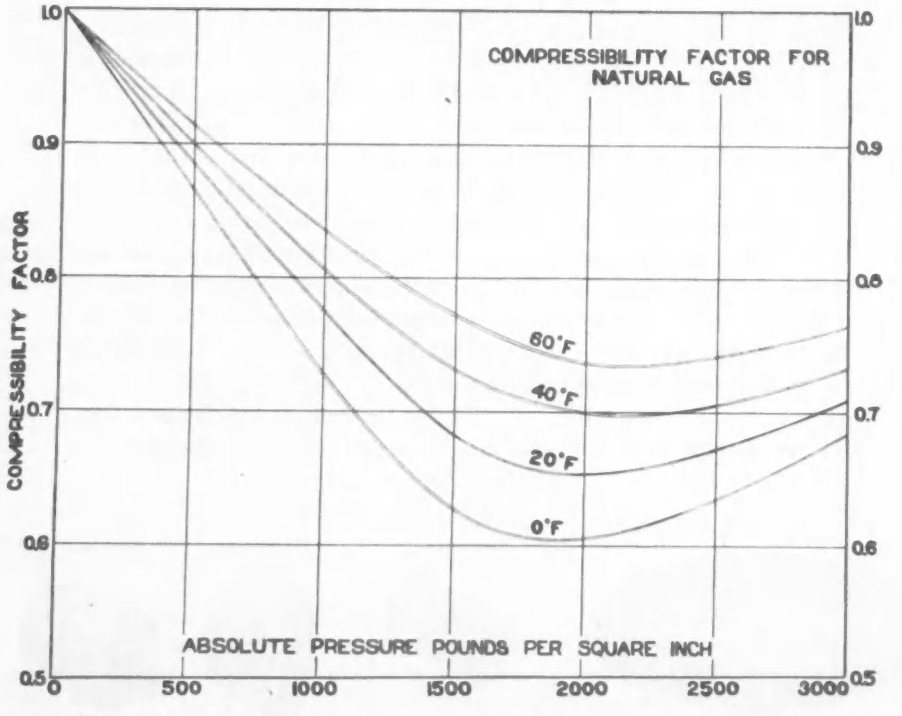
sure the compressibility factor of natural gas is near the optimum.

Of particular interest is the effect, in this type of storage, of the compressibility factor or the deviation from the laws of perfect gases of the natural gas stored. Fortunately, the maximum deviation occurs near 2240 pounds and is of such magnitude as to increase the storage capacity by more than 40 percent over that of a perfect gas, the compressibility factor "Z" (PV = "Z" NRT) being less than 0.70 at 2240 pounds per square inch and 40° F. Thus, whereas approximately 160 standard cubic feet of a perfect gas could be stored per cubic foot of space, approximately 230 standard cubic feet of natural gas can be stored per cubic foot of space. This was dramatically demonstrated when ten lengths of special pipe were pressured to 2300 pounds per square inch with 187,000 cubic feet of air whereas 260,000 cubic feet of natural gas was required to pressure the same ten lengths of pipe to 2240 pounds per square inch. Also, a high pressure cylinder was pressured to 2240 pounds per square inch with natural gas and the gas then carefully metered out in the laboratory. The metered volume was within one percent of the calculated volume. The nominal storage capacity of the Kankakee installation is 1,250,000 cubic feet; however, the actual gross storage capacity is 1,396,000 cubic feet at 40° F. storage temperature or 1,184,000 cubic feet at 60° F. storage temperature. The net available gas from storage is approximately 25,000 cubic feet less than the gross storage.



Pressure volume relationship of a perfect gas and of natural gas. Note that at 2240 pounds pressure, approximately 43 percent more gas may be compressed into a given volume than would be indicated by Boyle's law governing a perfect gas. This super-compressibility property of natural gas is one of the determining factors in making high pressure underground storage of natural gas economically attractive.



Compressibility factor for natural gas at various temperatures and pressures, indicating that at the design storage conditions of 2240 lbs. and 40° F. the compressibility factor is less than .7 or near the optimum for the 40° condition. At higher pressures the compressibility of natural gas again approaches that of a perfect gas.

The operating pressure of 2240 pounds per square inch conforms to the ASME-ASA Code for Pressure Piping, Section 2, Division 2, and is 80 percent of the mill test pressure of 2800 pounds per square inch. All piping other than the 24-inch special pipe conforms with Section 2, Division 1, of the Code for Pressure Piping. To withstand these high pressures, the special 24-inch OD seamless heavy wall pipe was made of API N-80 steel which has a yield point of approximately 80,000 pounds per square inch. The pipe has a minimum wall thickness of 0.448 inch and weighs approximately 5000 pounds per forty-foot length. Each length was hydrostatically tested to 2800 pounds per square inch in a water filled jacket, which procedure permitted the detection of any pipe in which the yield point was exceeded under test.

Depth at Which to Bury Pipe

The compressibility factor becomes more favorable with decreasing temperature; therefore, it is desirable to bury the pipe at a depth which will result in reasonably low temperatures in winter (say about 40° F. for the Chicago area) and yet minimize seasonal temperature changes. Due to the seasonal temperature changes, some gas must be withdrawn from storage in the spring and summer, and an equivalent amount put back into storage in the fall and winter. At the operating pressure of 2240 pounds, each 1° F. change in temperature will cause a pressure change of about ten pounds, of which about one-

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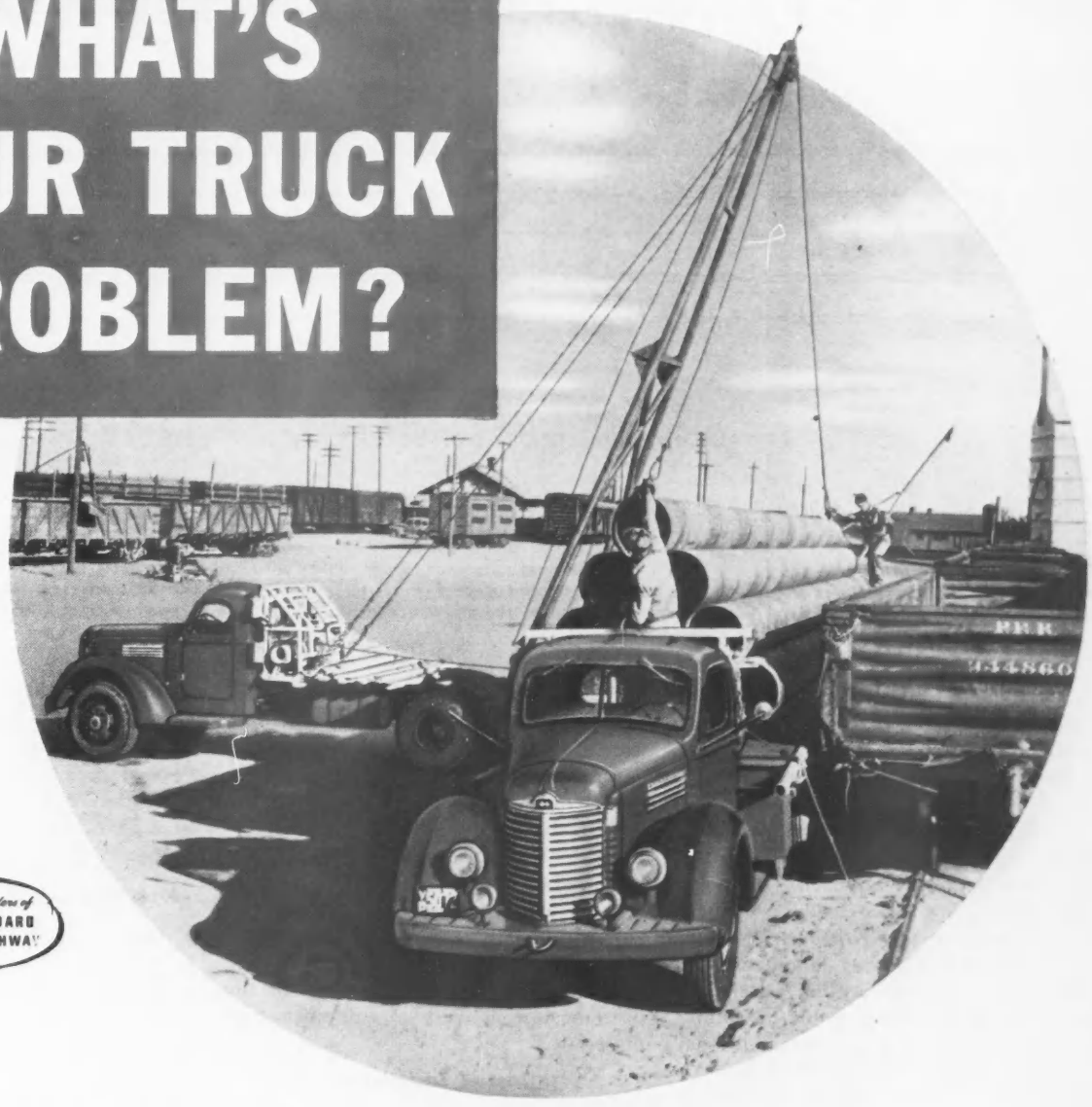

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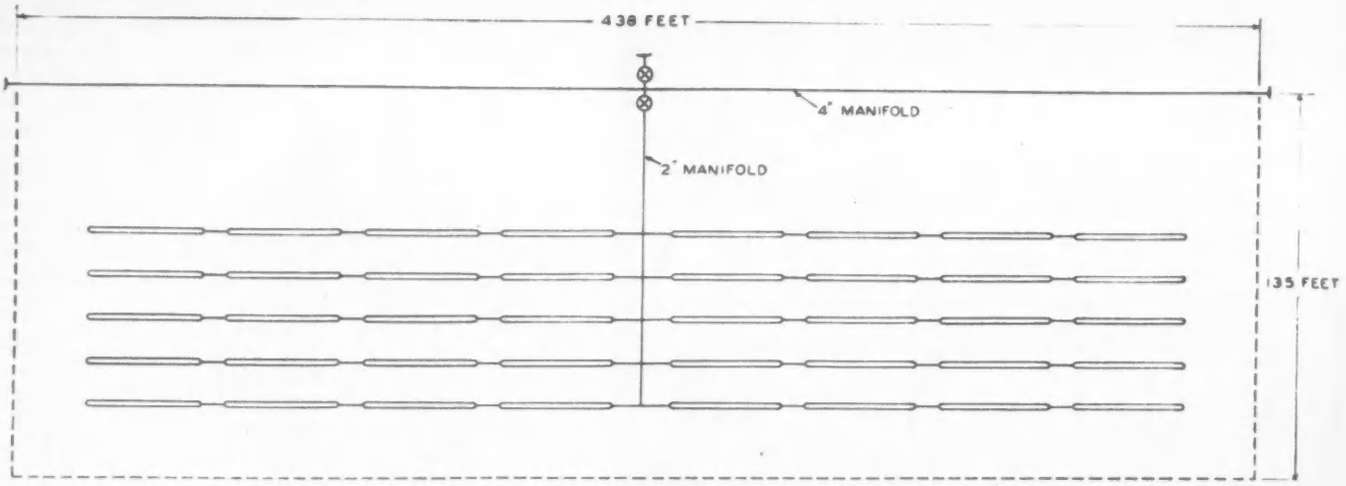

FORTY 40 FOOT LENGTHS OF SPECIAL 24 INCH PIPE

NOMINAL STORAGE CAPACITY 1,000,000 STANDARD CUBIC FEET

Typical arrangement of 40 pipe sections of 25,000 cubic feet capacity each, which makes up a one million cubic-foot unit of natural gas storage. In each such unit the pipe sections are spaced 8 feet end to end, and 15 feet center to center line. The 40 pipe sections or one million cubic-foot units were selected as a convenient size of unit since it is well within the size or capacity that is easy to operate or to take out of service for repair.

half is due to the change in the compressibility factor which accompanies the temperature change.

After the Kankakee installation proved entirely successful, from both cost and operating viewpoints, a similar but much larger installation was made in the Northern Operating Division. The existing facilities for peak load and emergency supply to this Northern Division area consisted of a gas manufacturing plant with five carbureted water gas sets, and a 5 million cubic foot low pressure holder. To provide additional protection against temporary failure or diminution of the normal natural gas supply, the company installed propane facilities and 40 million cubic feet of natural gas storage in buried pipe sections. These combined facilities have sufficient capacity to supply two maximum days' load with a gas consisting of approximately 50 percent natural gas, 25 percent propane gas, and 25 percent carbureted water gas. Such a gas comes well within the range of acceptable burning characteristics. All of these facilities are so installed and arranged that any one or all may be used for peak shaving if desired; that is, if on a very cold day the load should exceed the quantity of natural gas available from the pipe line, the deficiency would be supplied by these facilities.

This 40 million cubic feet of storage was installed and in service only six months after the start of construction and within one year after authorization to proceed. This may be considered very satisfactory, particularly in view of the present slow delivery of equipment and materials.

Cost of Installation

The cost of this 40 million cubic feet installation was in the order of $45 per 1000 cubic feet of gas storage capacity for the storage field. The total cost including the compressor and sendout station, land, engineering, etc., was in the order of $60 to $65 per 1000 cubic feet of gas storage capacity. When the ultimate storage of 70 million cubic feet is installed at this site, it is anticipated that the average cost per 1000 cubic feet will be in the order of $55.

While there have been no conventional type gas holders constructed in this area recently, our best estimate is that the cost of such holders today would be in the order of three to five times the cost of high pressure storage in buried pipe sections.

Advantages of High Pressure Storage

This type of storage has many advantages where it is applicable. Obviously, a considerable part of the favorable economics are incident to the super-compressibility of natural gas. Likewise, suitable land must be available at reasonable prices. About 75 million to 80 million cubic feet of storage capacity can be installed on 160 acres, with the spacing we have used. These are two two limitations. On the other hand, the relative appearance and the freedom from above ground hazards are certainly advantages. Also, we are in the early stages of a development and are finding opportunities for lowering costs and improving flexibility of design which we believe will lead to further advantages.

With over 40 million cubic feet of this storage installed and another 12.5 million cubic feet under construction by associated companies, and with some 40 million cubic feet planned for 1948 installation, our experience in construction and operation has shown it to be safe, reliable, economical, pleasing in appearance, and quickly installed. When required, a high percentage of the stored gas can be sent out at high rates of flow, with nominal investment in send-out equipment. We believe that this method of storage is ideal for many situations where natural gas must be stored.

About the Author

D. V. MEILLER, staff engineer of the Public Service Company of Northern Illinois, began his utility career less than a week after receiving a mechanical engineering degree from Kansas State College in June, 1927. Before he became a permanent fixture in the company's gas division ten years ago, he had worked in construction, engineering, sales, industrial relations, utilization, meter, and design, to mention just a few of his former positions.

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Continuous Film Records Right-of-Way

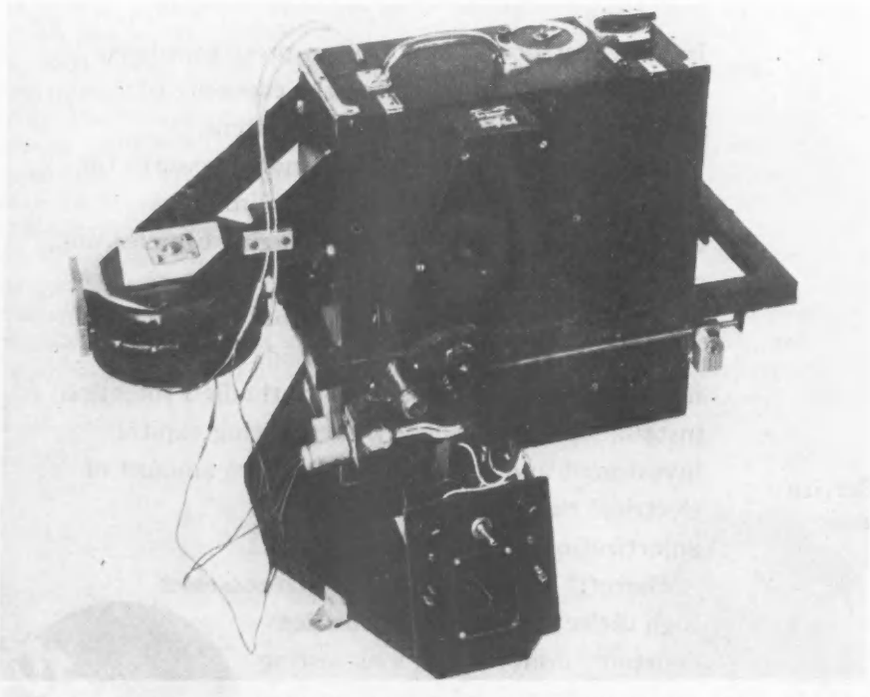
AN ADAPTATION of areial photography which provides continuous exposure over an area, as distinct from the photogrammetric method wherein a mosaic is made, offers a quick and reliable check of pipe lines and makes a permanent record which is readily examined for possible changes in right-of-way. The author presents results from surveys already run, and outlines development possibilities of the method.

By ANTHONY GIBBON
Staff Writer

ADAPTING a wartime technique which proved effective in military operations, the Airplane Pipe Line Patrol Service of Tulsa has completed what is believed to be the first major job of photographing a pipe line right-of-way on a continuous strip of film using a shutterless camera.

The work was done for Shell Pipe Line Company over a route which covered 428 miles between Cushing, Okla., and Wood River, Ill. Approximately 2000 feet of standard 35-mm film was used. About 30 actual flying days were needed to do the job. The completed film is a "camera's eye" view of the entire right-of-way and when projected on a screen provides a photographic record of the system, clearly showing washouts, exposed river crossings, and other hazardous conditions.

Primary purpose of the new technique, which is applicable on all pipe line right-of-ways with special emphasis on newly completed construction projects where erosion of soft backfills is most prevalent, is to enable competent pipe line maintenance engineers to check from the screen any section which may need immediate attention.



Modified shutterless camera used in making continuous film strip survey of Shell Pipe Line Company right-of-way between Cushing, Okla., and Wood River, Ill. Camera was suspended on gimbals in the rear of a plane and stabilized by gyro shown at left. Top right shows footage indicator and exposure control; triangular panel in center of camera contains synchronization mechanism, manually adjusted during period of flight to obtain maximum clarity of detail. This is the camera's outstanding feature.

Gleason Romans, general manager for the Airplane Pipe Line Patrol Service, which pioneered contract aerial inspection of right-of-ways, and Jack Beindorf of Tulsa redesigned an open-lens, continuous strip camera so that it might be adapted for pipe line photographic work. The camera used by the Army during war time is an expensive and heavy piece of equipment using film nine inches wide and, although it can do the same job, operation would be too expensive for commercial use.

Camera Design

The camera designed for the Shell survey weighs about 50 pounds, and the inventor is redesigning his equipment so that it will weigh even less, assure greater stability, and be more easily handled in a plane. It is 6 x 10 x 10", suspended on gimbel rings and maintained in a level position by a gyroscope in the rear of a cruising type plane.

The most significant improvement over the Army model is the installation of a device within the camera which assures perfect synchronization during flight. Because the plane which is used to take the continuous photograph must fly at altitudes not exceeding 300 feet and must frequently buck erratic wind currents, absolute stability was essential for successful operation. In Army use the military camera was synchronized before flight but because of critical wind and altitude variations the pictures not infrequently were distorted. The device in the Romans camera permits the operator to vary the speed of the film so as to catch the ground image without distortion or blurring. Synchronization is done manually and along the line of flight.

The survey for the Shell Pipe Line Company started at the Cushing, Okla., pump station and the plane, which for

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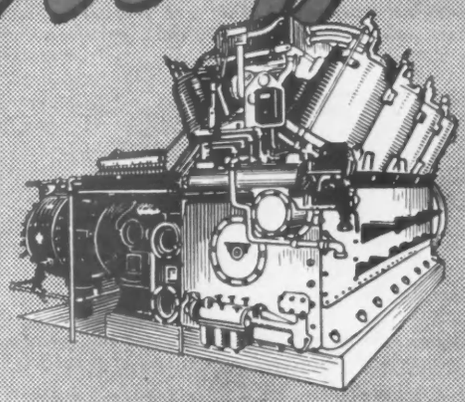

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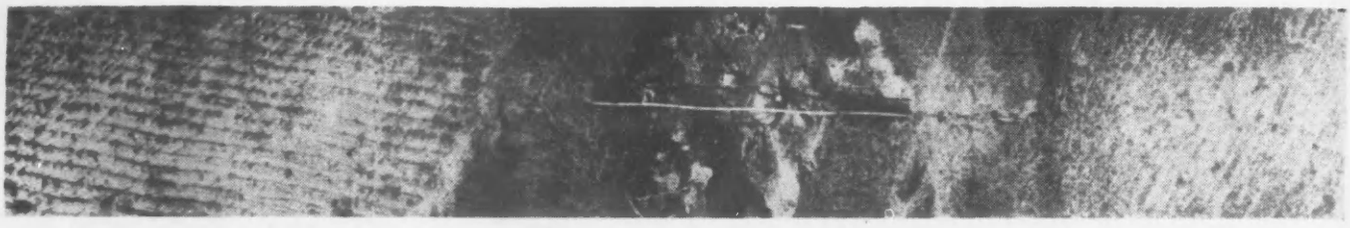
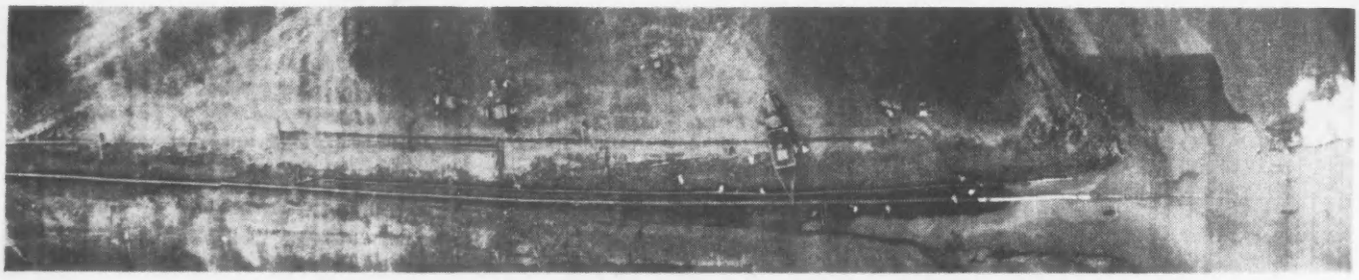
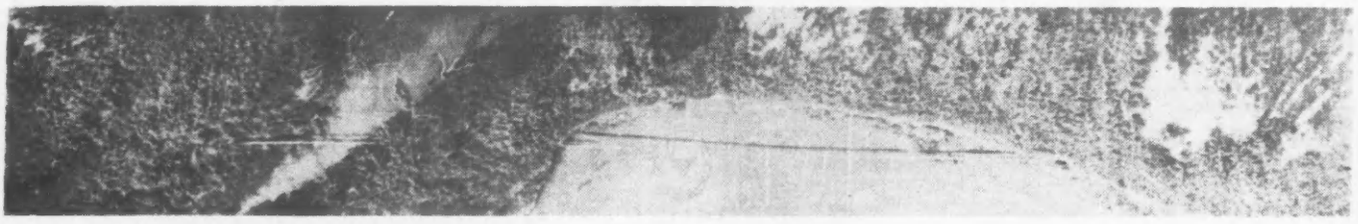


At mile post 61.2 the camera photographed a section of the pipeline (shown as a white line) which had been laid across a stream bed, the banks of which were eroding badly, causing the line to swing in a long unsupported span.



Taken at an altitude of approximately 200 feet during an experimental flight with the shutterless camera, this strip demonstrates the clarity with which images are recorded on the film. Note pipeline being moved by truck with boom and tackle as well as other ground features.



Pipe line engineers were under the impression that this section of eight-inch crude oil line was safely buried along the banks of the Washita river in Grady County, Oklahoma, until the camera revealed that the river bank had eroded and had left the line dangerously exposed and without proper support.

the first 300 miles was based at Tulsa, shot 200 feet of film on each hop between pump stations. This permitted photographing approximately 45 miles of right-of-way on each lap.

Flight Technique

Working from a right-of-way map supplied by the pipe line company, the photographer marked mile posts and pump stations on the film negative so as to enable engineers to orient any section of the line when the film is projected on the screen. The right-of-way followed two ten-inch crude oil lines. The survey was ordered primarily to determine the advisability of following the same route for the laying of a new and larger crude oil line. The film shows detail of terrain very clearly and at several points revealed unsuspected washouts with sections of line exposed, representing hazardous conditions. Trees and telegraph poles as well as landmarks are clearly discernible on the film which, when projected on the screen, appears to move at a speed of 35 miles per hour although the actual photographing was accomplished with the plane cruising at speeds between 75 and 90 miles an hour.

As a typical example of the clearness with which the camera reveals details, top photo, above, is a section of film showing a stream crossing. An examination of the strip shows badly eroded banks which have caused the line to swing in a long, unsupported span. (In the photograph the pipe line shows as a white line in the center of the strip). An interesting feature of the picture is shown at right which reveals how a backfill had been disturbed and softened and is gradually exposing a section of the line. The line originally was buried to a depth of three feet.

Middle photo, above, is a photographic strip taken during experimental flights and before the Shell survey was made. It is presented to further emphasize the clarity of the images obtained. Note the clear outline of the pipe line, the truck with boom and tackle, and other pictorial features.

Economic Considerations

From an economic standpoint it is believed the new technique will be of considerable service to pipe line companies as it will enable maintenance to be planned and designed with speed and accuracy, as well as prevent washouts at stream crossings through a comparison study of erosion activity. Romans points out that in right-of-way patrol work he has observed the loss of many expensive structures due to poor planning and a lack of sufficient knowledge of erosional activities in particular spots along the line by the planning engineers. Pictures taken at regular intervals more than compensate for their nominal cost.

Aerial photographing of pipe line right-of-ways on continuous film strip is recommended once a year. To compare existing conditions both films may be projected simultaneously on two screens. Changes during the intervening 12 months can be noted and adequate measures agreed upon during the showing.

In application the technique is relatively inexpensive, as continuous strip photography uses less than 5 percent of the amount of film required by an ordinary motion picture camera. The stretch of ground covered is limited only by the length of film that can be carried in the camera. The film capacity of the camera used on the Shell job is 200 feet. With improvements now in process the camera will be able to carry as many as ten rolls which will be interchangeable in the air, thus enabling a picture to be taken covering as much as 400 to 500 miles in a single flight.

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The biggest hazard to hauling heavy oilfield equipment, is bad weather and difficult running conditions—as you well know from sad experience. The most common cause is the fact that conventional "heavy-duty" trucks cannot haul off the road when the going gets tough.

The use of big, powerful, 100%-traction Walter Tractor Trucks is insurance against such hauling failures and delays—and keeps your rigs, pipe and servicing equipment moving on schedule, regardless of hauling conditions. Write for detailed folder explaining the advantages of Walter Tractor Trucks.

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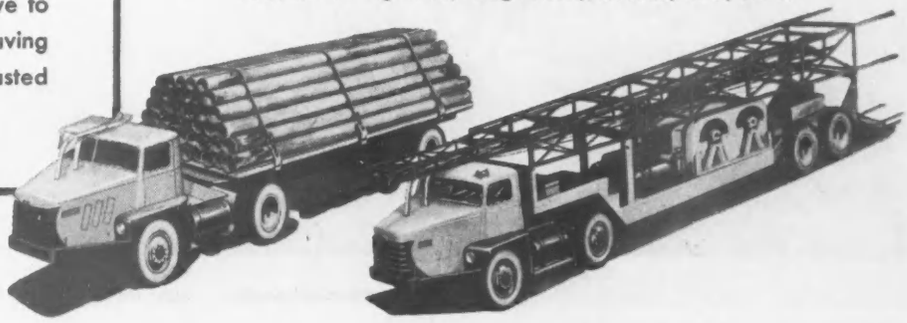


Magnesium Anodes for *Pipe Line Protection*

PRE-PACKED COMBINATIONS of magnesium anodes and backfill material find application in pipe line work where such a method may greatly reduce the amount of materials required, as well as speed up the installation. The author shows steps in the cathodic protection of a line in rough terrain.

By D. J. WALRAVEN
The Dow Chemical Company

BILLS for estimated billions of dollars for corrosion of underground and underwater structures are presented to the American people each year, with more than 200 millions of this amount attributed to damage done to the nation's pipe lines. Because these pipe lines measure over a quarter million miles and were built at a cost of 3 billion dollars, it is important that such widespread damage be curbed.

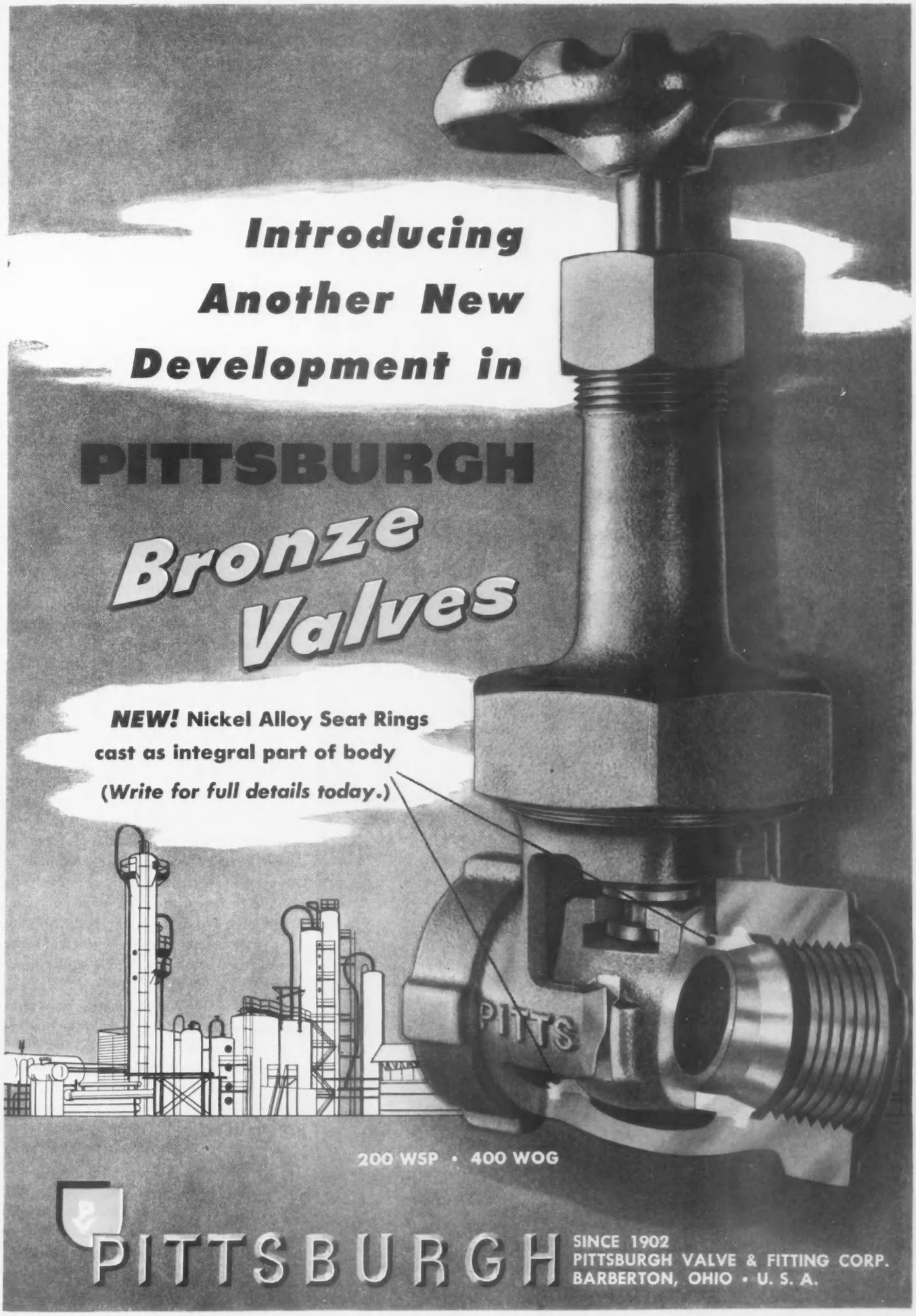
With causes of such corrosion known and remedial measures within reach, such destruction may be expected to be considerably lessened within the next few years.

Corrosion, basically electrochemical in nature, is caused by reactions between metal surfaces and chemicals in earth and water. Corroding metal surfaces are a series of small batteries with some areas acting as anodes and others as cathodes, while the earth or water surrounding the metal acts as an electrolyte. The anodic portions of the metal are dissolved to supply the electric current required by the cathodic areas, an action which continues until the supply of oxygen is exhausted or corrosion products seal it off.

Corrosion Control

Various methods of corrosion control for pipe lines and other metal structures have been tried and found helpful in some cases, useless in others. Probably the most advantageous method for use on bare lines and as additional protection for lines already coated and

Installing pre-packed anodes in eight-inch augered hole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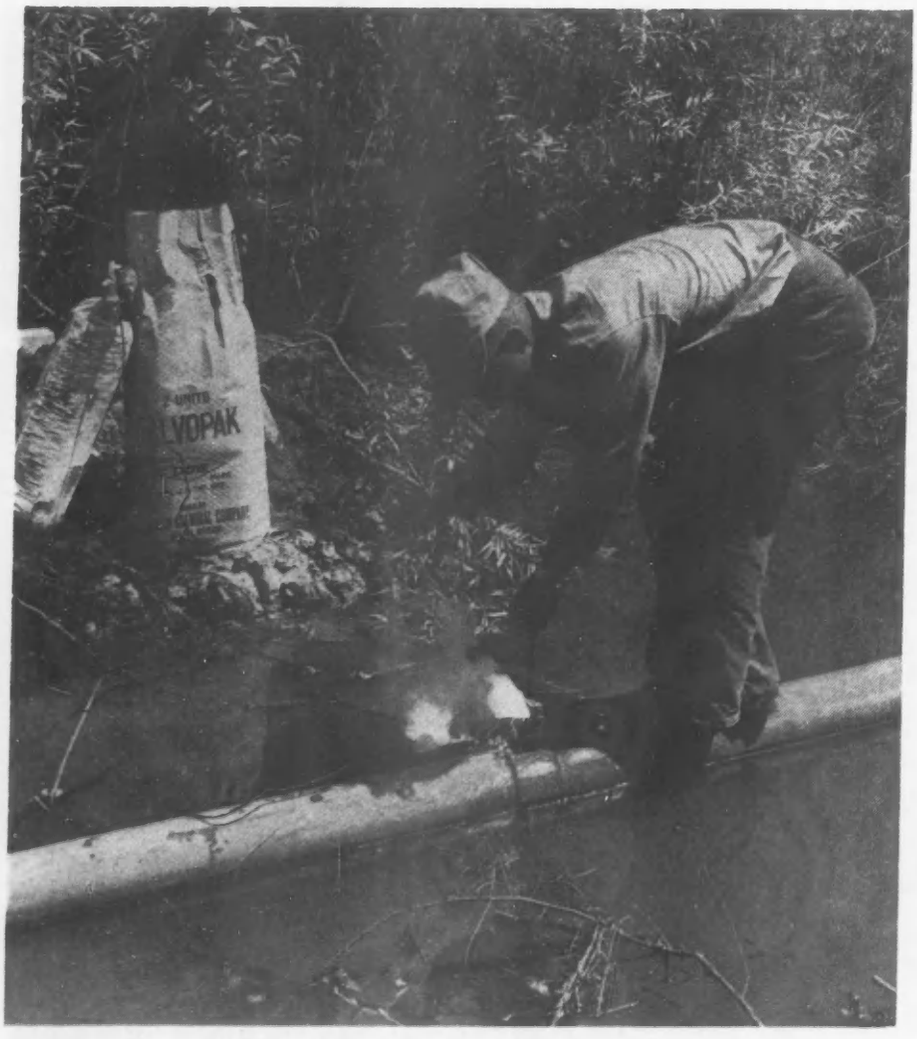
Pouring water on pre-packed anodes in hole before backfilling hole



Igniting thermit brazing powder to weld lead wire to pipe

wrapped have been the cathodic protection types of corrosion control, in which corrosion is stopped by using an external anode or source to supply the current demand of the local cathodes on the surface of the metal to be protected. Consequently, local anodic areas are saved because they no longer need to supply this current. The entire protected structure is the cathode of an electrolytic cell.

Anodes are of various materials, including scrap steel, carbon, or coke in ground beds. When these are used, an external source of power is necessary to supply currents running between the ground bed and the structure to be protected.

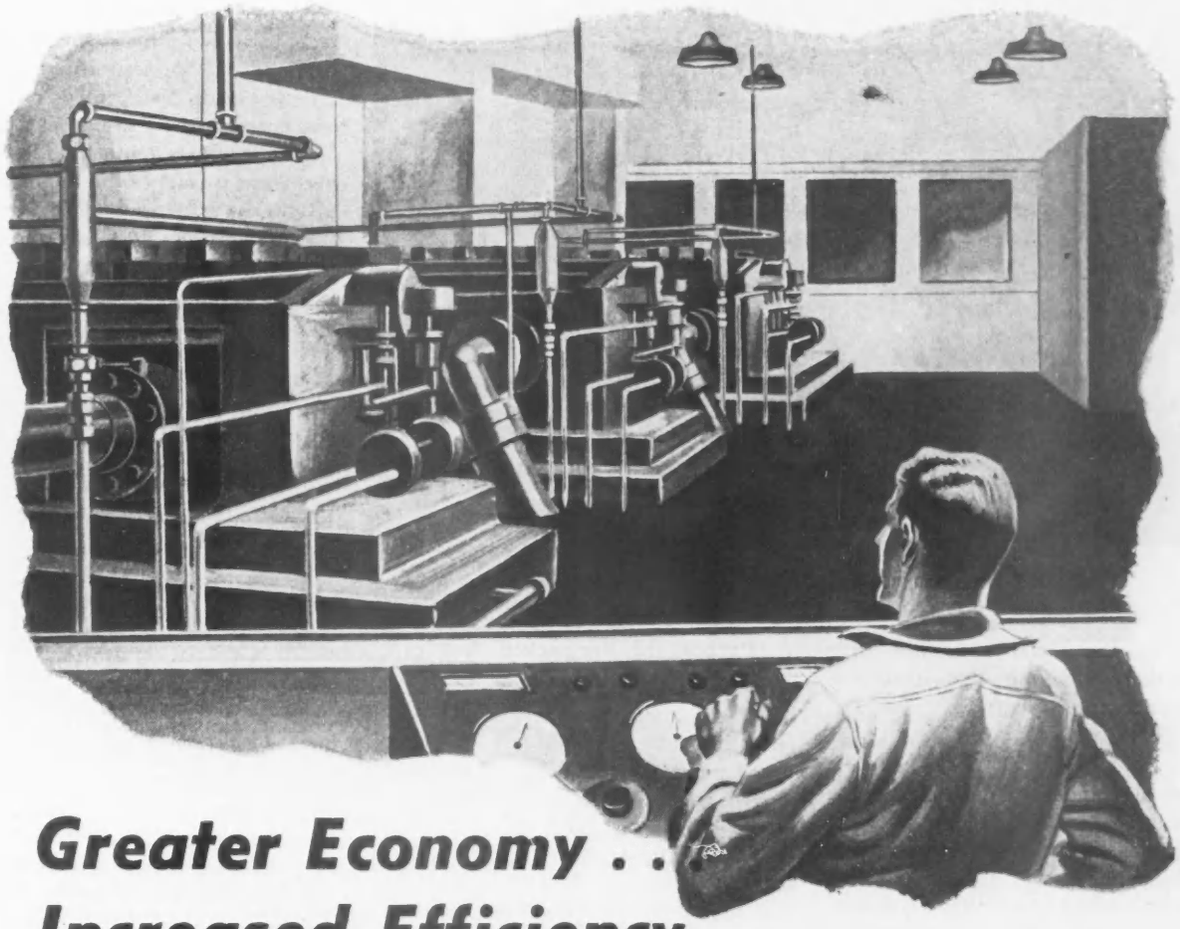
Magnesium Anodes

Among metals suitable as a galvanic anode for cathodic protection, extensive research at The Dow Chemical Company's laboratories and in the field have indicated that magnesium is effective. Reasons for this are its low electro-chemical equivalent, which permits it to store and release large quantities of electricity per unit weight of metal; its high driving voltage, which makes its stored electrical energy readily available; and its freedom from polarization effects, which permits continued production of electric current without interference by corrosion products.

A properly installed 17-pound magnesium anode has a life of about one ampere per year, thereby supplying ready and continuous current for protecting metal structures.

Magnesium anodes are made of high purity magnesium alloy. A ⅛-inch pipe is centrally located in the thickest section of the anode, and soldered to it is a ten-foot lead of well-insulated 12-gauge direct burial copper wire. Asphalt is poured in a recess in the top of the anode to shield the wire connection and core pipe from the magnesium so that the magnesium is not wasted in the protection of the core pipe and copper wire.

Anodes are buried in the soil after being surrounded by a suitable low resistance backfill (a medium in which the anode can operate more efficiently and retain longer life) which isolates the anode chemically and yet acts as an electrolytic "bridge" transporting electricity from anode to earth. This backfill is usually mixed with water into a pourable slurry. The copper wire which extends from the magnesium anode is connected to the structure to be protected and supplies the necessary current, with the result that the anodes are consumed instead of the anodic



Greater Economy . . Increased Efficiency in Pipe Line Operations with LOW-COST ELECTRIC POWER

Experience gained in construction and operation of new pipe line systems proves and justifies the trend to larger diameter lines, fewer pump stations, and simplified pumping equipment. Low-cost electric power enables you to attain the fullest economy in application of these three factors. Motor-driven pumps require less initial investment . . . less maintenance expense . . . and less for operation and labor. A minimum of attention and supervision is necessary when you have "pushbutton control" of your pumping equipment.

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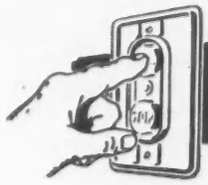

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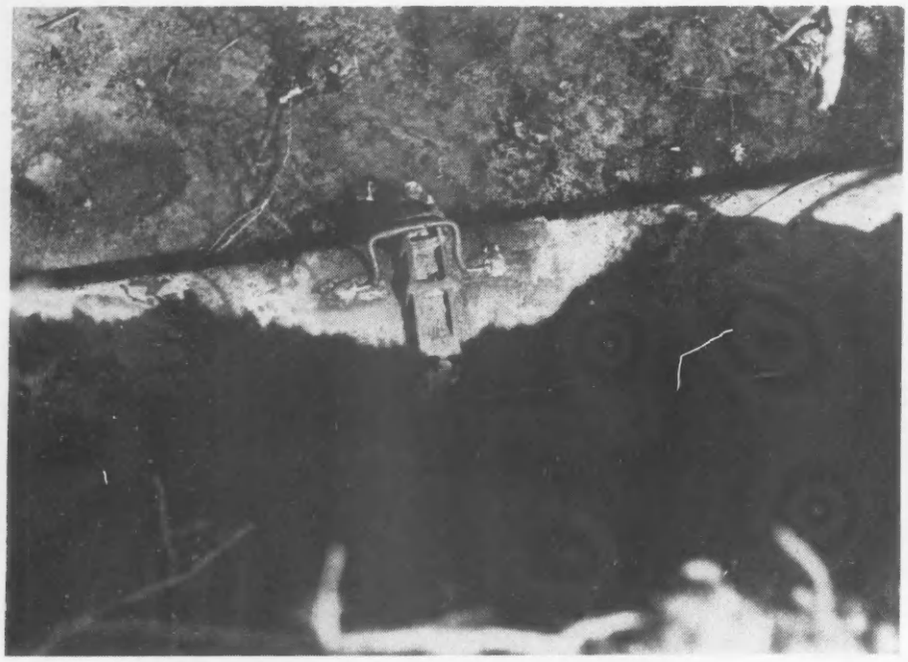

Jumpers across couplings—jumper thermit brazed to pipe line

portions of the metal structures they protect, thereby saving vital structures from corrosion.

Pre-packed Anodes

Magnesium anodes are also available in a recently developed anode package containing a standard magnesium anode with its lead wire and a premixed, dry powdered backfill specially processed for quick wetting. The unit is packed in a cloth bag which deteriorates readily following installation and the whole unit is packaged in a waterproof bag to allow storage in the field before the anode's installation.

When the separate anode is used, the following installation procedure is customary: Holes are bored in the earth adjacent to the structure to be protected, each hole deep enough to permit placing the anode about five feet below ground level or in a zone of permanent soil moisture. The hole is filled to a depth of from four to six inches with prepared backfill mixture, which must be purchased as a compound (or compounded by the user) and made into a slurry. To slurry the backfill in the field necessitates carrying a considerable amount of water and additional labor for mixing and pouring. The anode is centered in the hole on the mixture, and the hole filled to a depth of from four to six inches above the anode with more of the chemical backfill mixture. The remainder of the hole is filled with earth and the free end of the anode lead wire attached to the protected structure. Welded, brazed or soldered connections are preferred.

Purpose of Pre-packed Anodes

The purpose of the pre-packed anode is to eliminate several of these steps, and the package comes completely prepared for speedy installation. A loosely-woven string bag is placed around the anode which is then centrally located in a tightly-woven cloth bag containing the chemical backfill. This outer bag is wired shut, with the lead wire coiled outside the opening for convenience in installing. To install, this greatly simplified procedure is followed. Holes are bored in the earth, the pack placed in the hole, the hole filled, and the lead wire attached to the structure to be protected.

Frequently the pack is moistened after its installation and just before being covered with earth; sometimes it is soaked before installation. Occasionally, the anode is placed in the ground without prewetting or adding water. Which method is used depends upon moisture conditions in the installation area and how soon protection is required, as the anode will not produce current until the moisture reaches it.

The anodes may either be connected directly to the pipe or structure to be protected or several of them may be run to a collector wire which runs parallel to the pipe and is bonded to the pipe in one place, consequently saving many bondings to the pipe and necessitating only one excavation over the pipe.

Current Requirements

Current requirements for cathodic protection with magnesium depend on various factors, including soil conditions, the size and condition of the structure being protected, and the efficiency of current utilization.

Generally from one to three milliamperes per square foot is required to protect bare pipe in ordinary soils, depending on the uniformity of current distribution. Well-coated pipes need one percent of these figures.

The number of magnesium anodes necessary to supply the required amount of current is determined by finding the average current flow per anode at the particular site of installation. For this helpful tables are available from which an estimate can be made, based on a study of soil resistivity in the particular locality.

Location of the anodes depends greatly upon the surface condition of the pipes—whether they are well-coated or bare. For bare pipes, the anode should be located about ten feet from the structure with the anodes probably not more than 50 to 75 feet apart.

For well-coated structures the current density requirments are extremely low compared to bare metal surfaces because of the high resistance of the coating. Consequently, the placement of the anodes in relation to the structure does not materially limit the current distribution. On these lines where current distribution is controlled primarily by the resistance of the coating, anodes may be spaced several hundred feet to several miles apart, depending on the condition of the coating. Such conditions permit grouping of anode installations at the most convenient or effective locations along the line.

That magnesium anodes pay in cathodic protection has been proved by various leak record histories before and after application of the magnesium anodes. Leak records showed a decided decrease in dozens of reports following anode installation on both old and new pipe lines, coated, wrapped, and bare.

Local hot spots of several miles can be economically protected with magnesium anodes at a fraction of the cost of reconditioning.

Treating these hot spots by a distributed anode system has definite advantages. It is more efficient than a concentrated ground bed—which is also much more difficult to install—because current is not wasted by over-concentration in one spot to secure adequate protection in another; no external source of power is necessary; maintenance and service of equipment is eliminated; and voltage can be applied without the hazard of affecting other structures in the vicinity. With properly installed magnesium anodes, the pipe line is protected at all times.

Baash-Ross News

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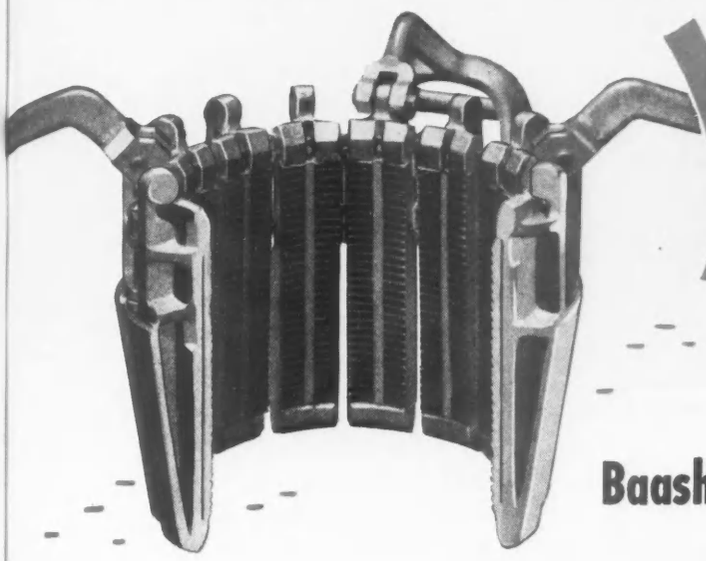
OUR 28th YEAR

...and again something new from BAASH-ROSS



Slips Specially Designed to safeguard thin-walled casing strings against crimping or other damage!

Baash-Ross Type "UC" Casing Slips

BECAUSE A STRING of casing has a relatively thin wall in relation to its diameter, it is much more easily damaged by unequal slip pressure than are drill pipe or tubing. Yet the weight of a string of casing—particularly under modern deep-hole drilling operations—can be extremely great... *so great, in fact, that even a slight misalignment of the slips or a moderate concentration of slip pressure can cause serious damage to the casing and might even result in losing the casing string down the hole.*

But such risks are now minimized through development by Baash-Ross of a new type of casing slip—the Baash-Ross Type "UC" Casing Slip. The Type "UC" Casing Slip consists of multiple segments, flexibly linked together so that they *w-r-a-p* around the casing like a chain tong to fit the exact curvature of the casing. Each individual slip segment takes the *same* uniform grip on the surface of the casing because *all* of the segments are unitized together—*act* as a unit, *set* as a unit, *grip* as a unit. This assures uniform slip pressure around the full circumference of the casing, eliminating risk of concentrated pressures that crimp the pipe and egg-shape the casing.

THREE BASIC BODY SIZES HANDLE WIDE RANGE OF CASING DIAMETERS

And here's an important point... Only *three* basic body sizes of "UC" Casing Slips are needed to handle *all* popular casing sizes from 7⅝" through 13⅜". As shown in the accompanying table, interchangeable liners are available for each of the three basic body sizes so that each size can be readily adapted to fit different casing sizes within its operating range...

Basic Body Size "UC" Casing Slips....	13⅜"	10¾"	9"*
Interchangeable liners available to fit.....	13⅜" 11¾"	10¾" 9⅝"	9" 8⅝" 7⅝"

**Fits bore and taper of standard rotary table.*

LINERS EASILY REPLACED

The liners in "UC" Casing Slips have ample length and are so designed that they will cut through pipe scale and any surface coating on the casing to take a firm, slip-proof grip *without damaging the surface of the casing itself.*

And if at any time after long usage, the liners become dull—or when changing from one casing size to another as outlined above—they can be quickly and inexpensively replaced. Simply pull a stainless steel pin, replace the old liner with a new one, slide the pin back in place and the job is done. The stainless steel pins eliminate risk of corrosion and assure easy liner replacements. Furthermore, it is important to note that none of the load of supporting the casing string is placed on retaining pins, bolts or any other parts that can become sheared or lost in the hole. *For maximum safety and strength all weight on the liners is transferred directly to the Slip body itself!*

HERE IS WHY *every casing job needs the protection of Baash-Ross "UC" Casing Slips!*

Because casing has a thin wall in relation to its diameter, it is easily crimped or damaged by even small misalignments that would not affect thicker-walled drill pipe or tubing.

If casing diameters vary slightly or if the slips are not set at exactly the same level, conventional rigid-type slips cause concentrated slip pressure that can crimp, bottle-neck or squeeze the casing out-of-round.

Such damage not only risks dropping the casing string, but the bulged or egg-shaped areas can cause poor joint make-up as well as tight spots through which tools cannot pass. Moreover, wear concentrated on the bulged spot leads to premature casing failures.

The flexible unitized design of Baash-Ross Type "UC" Casing Slips eliminates risk of one portion setting higher or lower than the other... and the multiple narrow segments assure an accurate, safe grip that exactly fits the curvature of the casing.

RESULT—there is no concentrated slip pressure—no misalignment of slip segments—no risk of damaging the thin walls of even the longest and heaviest casing strings!

Type "UC" Casing Slips are light, compact and easy for the crew to handle on even the longest and heaviest casing jobs. And they are so inexpensive that every casing job you run can have the protection of this new slip advancement. Your nearest Baash-Ross representative will be glad to supply full details... or write direct.

PIPE LINE *Construction*

PIPELINE construction intensified toward the year's peak activity during July and August and early September. Summer floods and bad weather in the Midwest delayed some jobs and shutdowns for delivery of pipe were frequently reported.

Headquarters were opened at Springfield, Mo., for the Ozark Pipe Line System of Shell Pipe Line Corporation and The Texas Pipe Line Company, which is due to begin construction by October 1. The 435-mile 22-inch oil line will extend from Cushing, Okla., to Wood River, Ill., then 54 miles further to Patoka, Ill. The Texas Pipe Line Company, Shell Pipe Line Corporation, Empire Pipe Line Company, and Sinclair Pipe Line Company have awarded contract for the last spread of their Basin Pipe Line System, 170 miles of 24-inch crude line into Cushing.

Stanolind Pipe Line Company has awarded contracts for the construction of approximately 580 miles of 8-inch, 10-inch, 12-inch and 16-inch loops on its main line carriers in Wyoming, Nebraska, Kansas, Texas, and Oklahoma. Construction is to be completed before the end of the year and will increase deliveries of crude to refineries served by Stanolind by 46,000 barrels per day. The Casper, Wyo., to Freeman, Mo. trunk lines and the West Texas to Drumright, Okla., systems were those being increased.

Sinclair Refining Company's products system from the Atlantic to the Great Lakes to tie in with the converted and enlarged system being constructed from Texas Gulf Coast reported steady progress. It was the only major products line construction under way at present in the U. S.

Tennessee Gas Transmission Company continued its huge construction program and is making use of the 30- and 31-inch pipe formerly designated for the Trans-Arabian Pipe Line to carry forward the completion of its second parallel line from the Lower Texas Coast to West Virginia. Approximately 207 miles of the large-diameter pipe will be used.

Trans-Continental Gas Pipe Line Company, which has received FPC approval of its proposed 1845-mile line is developing its organization and plans to begin construction by May, 1949.

Trunkline Gas Supply Company amended its application to FPC, which has been long pending and is scheduled for a new hearing September 8. A change of origination of the line to Lake Charles, La., instead of Wharton County, East Texas, and reduction to 768-miles of 26-inch instead of 855 miles of 30-inch may increase its chances of approval.

Pipe Line Construction

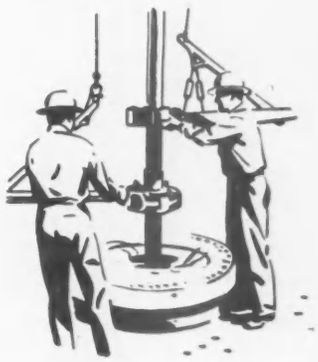
Table includes projects planned, contracts awarded, and spreads or entire projects completed since the last issue of WORLD OIL

COMPANY	Origin and Terminus	Length (Miles)	Pipe Size (Inches)	Daily Capacity (Barrels Cu. Ft.)	REMARKS
CRUDE OIL LINES					
Anglo-Iranian Oil Co., Ltd.	Agha Jari field to Mashur station, with lateral to marine terminal on Persian Gulf	56 25	20 & 22 8 & 10	100,000	Pipe export approved by U.S. Commerce Dept.; construction to start shortly.
The Atlantic Pipe Line Co.	Horton station to Camps loading rack, East Texas	5	8		Titsworth and Partain, Kilgore, Texas, began construction July 12.
	Block 31 field terminal, Crane Co., West Texas, to Corpus Christi, Southwest Texas	400	10	45,000	Company contemplating construction of second outlet for 1950.
Attock Oil Co.	Balkassar and Joya Mair fields to junction with Dhulian-Rawalpindi pipeline, Pakistan	35	8		Construction activity resumed.
Cooperative Refinery Assn.	Hoosier station to point northwest, Kans.	20	8	18,000	Jayhawk Construction Co., Great Bend, Kans., constructing.
	Continuation of line to Valley Center, Kans., terminals	48	6		Contract to be awarded.
Corporación de Fomento de la Producción	Cerro Manantiales to marine terminal at Caleta Clarence on Bahia Gente Grande, Tierra del Fuego, Chile	45	8		Survey completed. Proposed construction includes 1 pump station and tankage.
Humble Pipe Line Co.	Point 4 miles from Refugio station toward Ingleside, Southwest Texas	8⅗	8		Extension of No. 3 8-inch line started mid-August by Stuart Lease Service, Beeville, Texas.
Imperial Oil, Ltd.	Leduc field to Moose Jaw and Regina, Canada	500	16		Company negotiating for 80,000 tons of pipe.
Magnolia Pipe Line Co.	Miranda field gathering line, Southwest Texas	6½	4		Shanks & Eustace, Alice, Texas, constructed.
Phillips Petroleum Co.	Goldsmith field gathering system, West Texas	5 10	24 8 & 10		Vaughn and Taylor Construction Co., Wichita Falls, Texas, constructing; new work being added to original contract.
Phillips Pipe Line Co.	Loop on line from Goldsmith field to Borger refinery, Texas Panhandle	7	12		Contract awarded to O. R. Smith Contracting Co., Ft. Worth is initial spread on 315-mile line paralleling present carrier, which will get under way late fall.
Shell Group	El Dificil field to Plato station on Andian Pipeline Co.'s Barrancabermeja-Mamonal line, Colombia	48	6	3,000	Line expected to be in operation mid-September.
Sinclair Refining Co., Pipe Line Dept.	Creek and Tulsa counties, Oklahoma	39	4-8		Takeup job started by Atlas Construction Co., Tulsa: also laying of 2½-miles 6-inch line same area.
Skelly Oil Co., Pipe Line Dept.	Near Burrton, Kans.	9 7½	3 & 6 3, 4, 6		9-mile takeup job, 7½-mile construction completed by Atlas Construction Co.
Stanolind Pipe Line Co.	Lawrence, Kans., to point in southern Nebraska	65	16		Contract awarded to R B. Potashnick, Cape Girardeau, Mo. Work starting late August.
	Gothenbury to Scotts Bluff, Neb.	67	16		R. H. Fulton & Co., Lubbock, Texas, awarded contract for looping.
	From Matador, North Texas From Douglas, Wyo. Pump station, 11 miles north of Lubbock, West Texas	31 56	16 12 & 16		Work near Douglas includes 44⅗ miles 8 and 10-inch pipe to be taken up and reconditioned. Fulton Engineering Co., Lubbock, Texas, to complete Nov., 1948.
	Gotebo to South Canadian River, Okla.	51	16		Smith Contracting Co., Ft. Worth, constructing.
Southern Pipe Line Corp.	Odom pump station to W. Sinton, Southwest Texas	11⅗	4		Shanks & Eustace, Alice, Texas, completed.

Inspection

WELD CASING AND TUBING

The Best Your Money Can Buy!



● Unlike tubular products manufactured by other processes, Republic Casing and Tubing are made from *flat-rolled steel*, cold formed and electric resistance welded. This advanced method brings you finished products with two exclusive advantages:

FIRST—every square inch of *both* surfaces is open to complete visual examination. Thus, the inside wall surface is just as free from hidden defects as the outside.

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Other Republic Products include Line Pipe—Carbon, Alloy and Stainless Steels—Upson Studs, Bolts and Nuts—Electrunite Heat Exchanger Tubes

Pipe Line Construction—(Continued)

Table includes projects planned, contracts awarded, and spreads or entire projects completed since the last issue of WORLD OIL

COMPANY	Origin and Terminus	Length (Miles)	Pipe Size (Inches)	Daily Capacity (Barrels Cu. Ft.)	REMARKS
The Texas Pipe Line Co.	East Houston to Port Arthur, Upper Texas Coast	78	20	120,000	Latex Construction Co., Houston, completed.
	West Columbia station to East Houston station, Upper Texas Coast	60	16	60,000	Contract awarded to Latex Construction Co., Houston. Line links at East Houston with completed 20-inch carrier.
The Texas Pipe Line Co., Shell Pipe Line Corp., Empire Pipe Line Co., Sinclair Pipe Line Co.	Wichita Falls, North Texas, to Cushing, Okla.	170	24	.....	Contract on final spread of Basin Pipe Line System awarded to Smith Contracting Co., Ft. Worth. Construction started Mid-August.
PRODUCTS LINES					
Antioquia Railroad	Puerto Berrío to Medellín, Colombia	111⅛	6	.....	Contract completed with Colombian Government's Ministry of Mines and Petroleum. Line to be operating within 3 years.
Phillips Petroleum Co.	Dumas gasoline plant to existing line, Moore County, Texas Panhandle	19½	4	.....	Vaughn and Taylor Construction Co., Wichita Falls, Texas, started project, but shut down waiting on right of way.
Sinclair Refining Co.	Tank farm near Chelsea, Deleware Co., to terminal near Philadelphia, Pa.	26	8	34,200	Construction under way by John Meehan & Son, Philadelphia, and Ralph Hopple, Canton, Ohio. Project includes 1—1445-HP station. To complete Nov. 1.
NATURAL GAS LINES					
Compania Mexicana de Gas de Monterrey	Mision and Camargo fields, near Reynosa, to Roma-Monterrey line, Mexico	37	12	30 mln	Completing construction of line and preparing to build gas processing tanks at field.
Egyptian Natural Gas Co. (Salem, Ill.)	Point near Norris City to vicinity of Centralia and Salem	40 40	8 6	20 mln	Application to FPC.
Hunt Oil Co.	Carthage gathering and transmission line, East Texas	7	4 & 7	.....	Titsworth and Partain, Kilgore, Texas, constructing line.
Iroquois Gas Corp. (Buffalo, N.Y.)	Looping of existing line	13	22	.....	Application to FPC, includes enlargement of existing storage fields and development of a new storage field.
Lavaca Pipe Line Co.	From 4 gas wells in Matagorda Bay to Aluminum Co. of America's plant at Point Comfort, Upper Texas Coast	11½	8	.....	Continental Construction Co., Port Lavaca, Texas, Completed line.
Lone Star Gas Co.	Opelika field, Henderson Co., to Greenville, North Texas	70	20	.....	Eastern Construction Co., Dallas, starting construction Mid-August.
Natural Gas Pipe Line Co. of America	Hooker, Okla., compressor station	.....	.....	.....	Fulton Engineering Co., Lubbock, Texas, completing September 1.
Northern Natural Gas Co.	Loop from Clifton station northeast to Washington Co., Kans.	12½	24	.....	Approved by FPC; includes 1.14 miles of loop from Mullinville, Kans., station to north to replace existing line.
	Gathering line north of Sublette station, Kans.	6	8	.....	Brodie Construction Co., Hugoton, Kans., completed.
	Gathering line northeast of Sublette	19	6	.....	Brodie Construction Co. completed; also took up 17 miles 6-inch in same area.
	Northwest of Sublette	12½	16	.....	R. H. Fulton & Co., Lubbock, Texas, starting line in Sept.
	Third line north of Clifton station	11	24	.....	C. S. Foreman Co., Kansas City, Mo., constructing.
Oklahoma Natural Gas Co.	Near Ardmore, Okla.	13	10	.....	Contract for short lines to be let September 1; also for 2 miles of 12-inch line near Stroud, Okla.
	Near Tulsa, Okla.	9	6, 12, 16	.....	
Pacific Gas and Electric Co.	Existing terminal near Milpitas, Santa Clara Co., Calif., to point on state boundary near Topock, Mohave Co., Arizona	510	.....	150 mln	Line to connect with existing lines to San Francisco area carry gas from El Paso's proposed San Juan Basin line. Application to FPC.
Panhandle Eastern Pipe Line Co.	Dumas compressor station, Texas Panhandle	.....	.....	.....	Fulton Engineering Co., Lubbock, Texas, enlarging facilities. Scheduled completion February, 1949.
The Peoples Natural Gas Co.	Gas field near Kensington to station east of field, Pa.	12	12	.....	Williams Brothers, Tulsa, completing September 1.
Phillips Petroleum Co.	Field gathering system in Texas Co., Okla., and Sherman and Hansford counties, Texas Panhandle	40 9 12 10 25	24 16 14 10 8	.....	Vaughn and Taylor Construction Co., Wichita Falls, Texas, started construction in August. Scheduled completion in November.
Potomac Gas Co.	Connection with Virginia Gas Transmission Corp. near Dranesville, to Arlington, Va.	18	16	30 mln	Temporary approval by FPC.
Public Service Co. of Northern Ill.	Wedron to Ottawa, Ill.	6	12	.....	Midwestern Contractors, Chicago, completing in Sept.
Southern California Gas Co.	Santa Fe Springs to Pasadena-Alhambra area, Calif.	12	30	.....	Alex Robertson Co. and Pacific Pipeline & Engineers, Los Angeles, are constructing.
Southern California Gas Co. and Southern Counties Gas Co.	Loop on existing line from point near Whitewater to jct. with Pasadena lateral near Montebello, Calif.	88	30	100 mln	Application to FPC. Construction proposed for November, 1948.
	Point on existing line, near Rivera to Slauson station, Los Angeles	15	30		
Southern Natural Gas Co.	Georgia looping	6½	24	.....	To be constructed. Approved by FPC.
	Branch line looping, Gwinville field, Miss.	5	8		
	Compressor station between Gwinville field and Pickens station, Miss.	.....	.....	.....	
Stanolind Oil & Gas Co.	Gathering system Hugoton field, near Ulysses, Kans.	180	2-30	.....	Deaton & Sons Pipe Line Construction Co., Odessa, Texas constructing.
Tennessee Gas Transmission Co.	Second line loops	207	30 & 31	.....	FPC approved application to substitute for 213 miles of 26-inch loops previously authorized.
Texas Eastern Transmission Corp.	Hastings field, to 8-inch line near Baytown, Upper Texas Coast	8	20	.....	To be constructed.
	Provident field, Lavaca Co., to existing 20-inch at Baytown	100	16		
	Four compressor stations on 20-inch line	.....	.....		
	Loops on line south of Lisbon	70	20	235 mln	Application to FPC.
	Loops on line beyond Lebanon, Ohio	178	26		
	Enlarging compressor stations by 15,000 HP	.....	.....		
Trunkline Gas Supply Co.	Point near Lake Charles, La., to point near Keokuk, Iowa	768	26	339½ mln	Amended application to FPC.
United Gas Pipe Line Co.	Baxter field, Miss., to Mobile, Ala.	90	.....	.....	Construction contemplated.
Western United Gas and Electric Co.	Globe refinery, Lemont, Ill.	5	6 & 8	.....	Completed by Midwestern Contractors, Chicago.
Warren Petroleum Corp.	Gathering system at Maysville, Okla.	120	.....	.....	Holland Construction Co., Tulsa, started part of project
Washington Light Co.	Near Church Falls, Virginia	25	16	.....	Holland Construction Co. constructing.

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Marmon-Herrington *All-Wheel-Drive* Trucks give you tremendous tractive power—*where you need it, when you need it.* With front wheels pulling, rear wheels pushing, these great trucks are "made-to-order" for really tough trucking jobs—jobs too difficult or altogether impossible for trucks of conventional drive.

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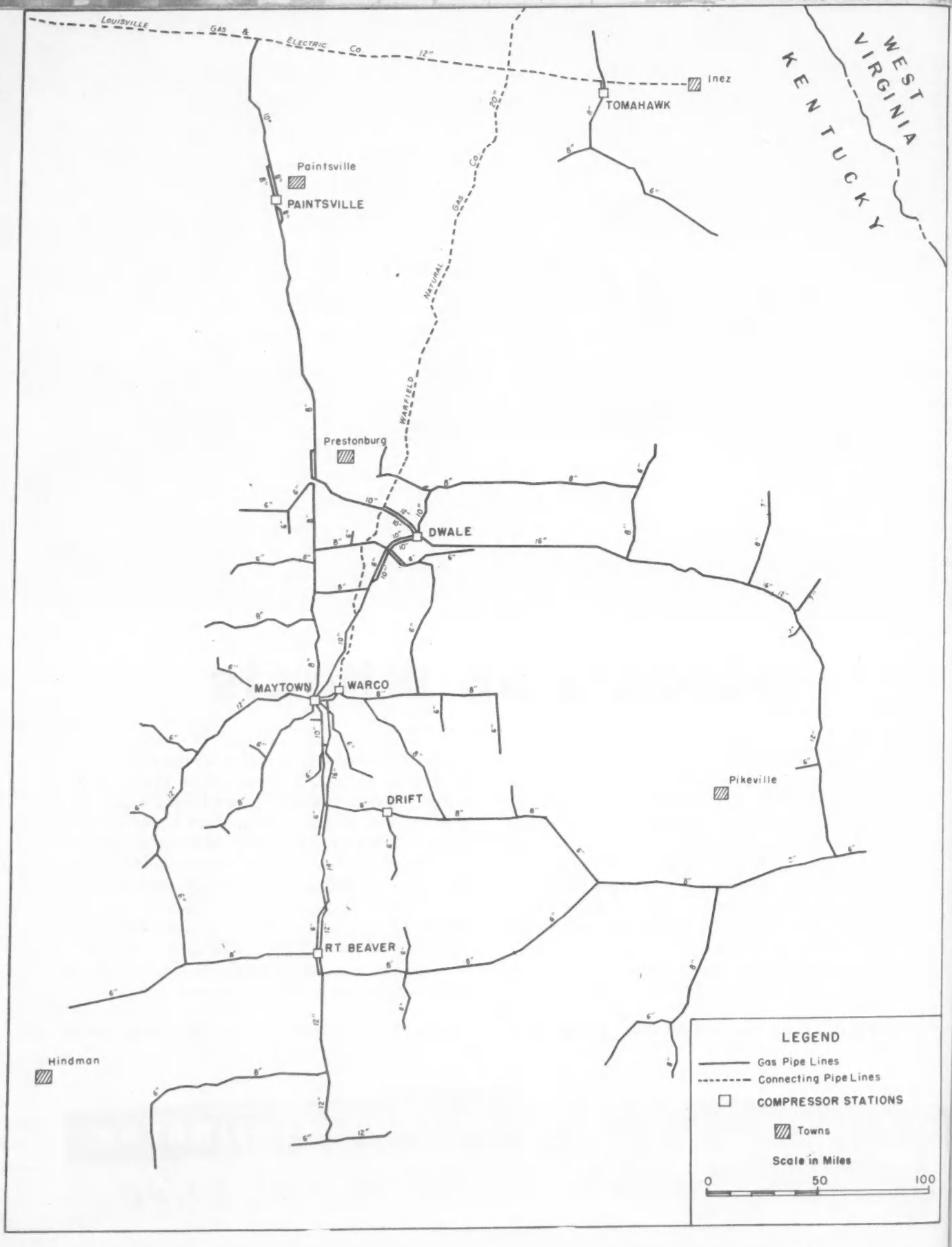

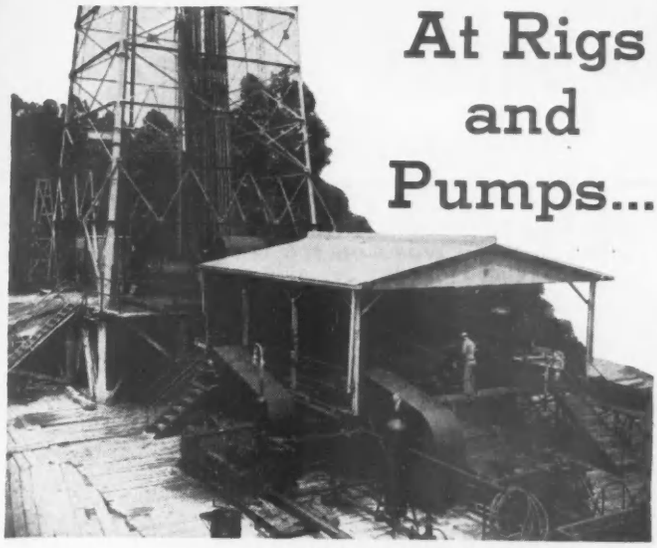

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At Rigs and Pumps...

...men say "WICO" instead of "Magneto"

And well they may, for the reputation of WICO magnetos has led all the rest for two score years wherever oil comes in. Oil men know that in sand or swamp, however rough the conditions, WICO magnetos deliver the hot, strong, reliable spark that's the heartbeat of the engine.

WICO magnetos stood the test of years of use on all kinds of internal combustion, spark-ignited engines in oil fields all over the world. Every new WICO model is tested for days in a "dust bowl" at the laboratory where extra fine, highly abrasive sand sweeps around the operating magneto. In a nearby humidity box, with 100° temperature and 95% humidity, each WICO model runs continuously day after day — for thousands of hours — while moisture drops on and from it.

No wonder men at the rigs and pumps say "WICO" instead of "magneto". That way they *know* they'll get topflight magneto performance.

Trained field engineers and more than two thousand authorized service stations serve WICO users everywhere. Wico Electric Company, West Springfield, Massachusetts.

SINCE 1897

WICO

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RIDGID economy guaranteed

. . . and you like its work-saver features, too

● The RIDGID housing guarantee is just one of the reasons why the RIDGID heavy-duty pipe wrench is the favorite of men who know fine tools—all over the world. Note the easier-work features: adjusting nut in open housing spins easily in all sizes 6" to 60"; handy pipe scale on hookjaw; instant-action non-slip non-lock jaws; powerful comfort-grip I-beam handle. No wonder RIDGIDs are the most popular pipe wrenches made. You'll prefer them, too. Buy them at your Supply House.

Handy end wrench for pipe in coils or against flat surfaces.
UNCONDITIONAL GUARANTEE
If this Housing ever Breaks or Distorts we will replace it Free
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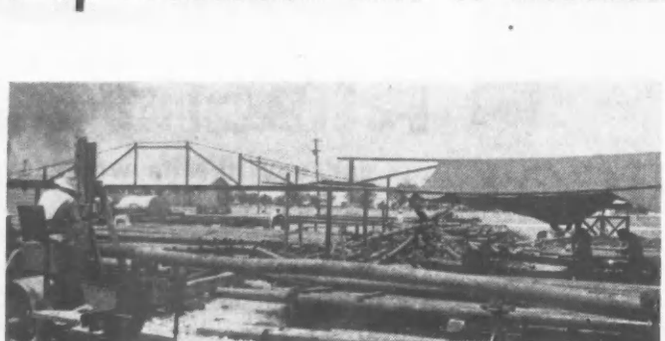
PIPE LINE HINTS

$10 is paid for each illustrated acceptable contribution. Mail to The Editor, WORLD OIL, P. O. Box 2608, Houston 1, Texas

HOW TO—Set Up Production Line to Recondition Pipe in Field



The current shortage of pipe of any description has brought about considerable reconditioning jobs involving line pipe normally discarded. When one pipe line company had a large quantity of pipe to recondition, a production line operation was set up. Important in the reconditioning program was the straightening of random joints made up by welding usable pieces of reclaimed pipe.

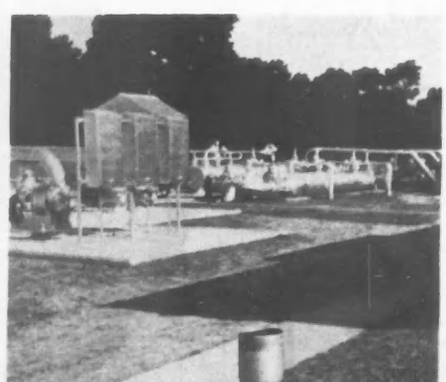
Old pipe dug up from the line was trucked to the reconditioning area and racked. Welders then cut bad sections from each joint and welded the remaining pieces together to form a joint of approximate standard length. Many of these joints thus fabricated were crooked either because of imperfect welding or because of bends existing in the line when it was excavated.

After the joint had been welded, it was racked adjacent to the portable pipe straightening machine. An operator and two helpers were required to handle the pipe during the process. A crooked joint was rolled up to the machine and set in position. Opposite end of the joint was supported by a variable height support on which was mounted a concave roller. The operator's position was at the hydraulic straightener, making it possible for him to have complete command of the procedure. He had control of the operating valves. When one section was straightened, the helpers pushed the pipe through the machine to the next crooked section. The pipe was fed through the machine in this manner, with each straightened joint being racked again for pressure testing and further inspection. These devices are completely portable and can be set up in the field along the line.

HOW TO—Construct Sampling Stand to Test Contents of Pipe Lines

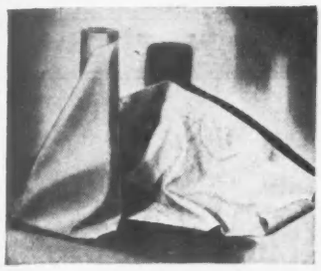
To provide sampling of the fluid which is actually passing through either of its two main lines at the time, one pipe line company carries ⅜-inch pipe bypasses from the line through a sampling stand. The two loops are tied together at the highest points by a short lateral connection in which is incorporated a tee. The riser of this tee carries a short nipple and valve for sampling, and above that fitting is a second tee which leads to the feeder lines in the two hydrometer wells.

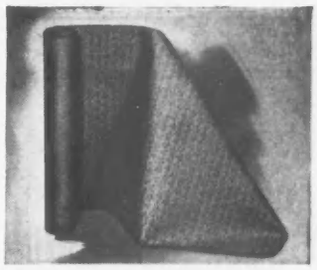
Under normal operation the fluid circulates through the loops, being kept from entering either well by the closed valve in the feeder line. To fill the well, it is necessary only to open the feeder valve and close the gate in the outlet leg of the bypass loop. Oil is circulated through the well until it is clear of gas or entrained material, and the outlet valve at the base of the well is then closed. The outlet valve in the loop is then used to regulate the flow into the well, and the section is cut off when the desired level is reached.



The two wells are covered by housing which not only serves to trap overflow, but which also protects the hydrometers when not in use. The drop front allows a view of the hydrometer scales, closing the unit against weather while not in use. The hinged top has a flange which fits over the front so as to make a weather-tight closure.

Both wells drain to the station sump system, so that fluid used for gravity determinations may be cleared from the system. The fitting between well and control valve is small enough so that hydrometer tip is protected from possible contact with the moving valve parts.





Upper left:
GARLOCK 22 Red Rubber Sheet Packing

Upper right:
GARLOCK 660 Cork-Fibre Sheet Packing

GARLOCK 7021 Compressed Asbestos Sheet Packing

Going Places!

Yes, Garlock is going places with sheet packings because one of the many Garlock sheet packings answers *every* requirement efficiently and economically. Three widely used Garlock gasketing materials are:

GARLOCK 7021 Compressed Asbestos Sheet—exceptionally strong and tough. Gives superior service against gasoline, oil, gas or steam at high temperatures and extreme pressures.

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GARLOCK 660 Cork-Fibre Sheet Packing combines granulated cork and vegetable fibre into a strong compressible sheet, treated with an oil resistant binder. An ideal gasketing material for oils and solvents at temperatures up to 212° F.

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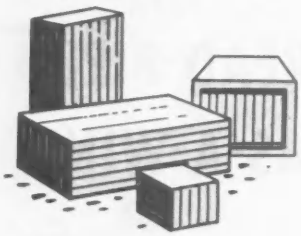
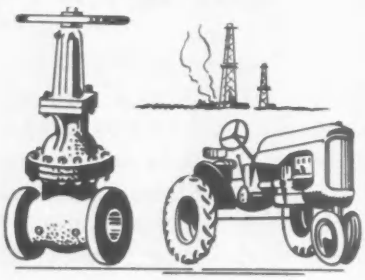
ANY TYPE CRATE



FOR ANY KIND OF PRODUCT



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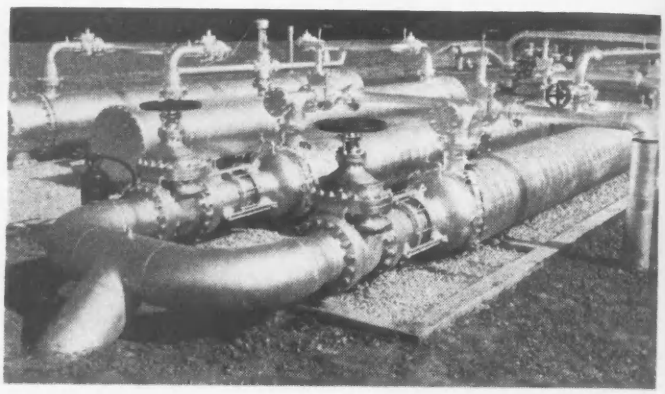
HOW TO—

Mount Exchanger for Quick Removal



Where dual exchangers are used with the line throughput to cool the engine jacket water, means must be provided for quick removal of a unit if work on the interior is required. One pipe line company mounts the exchanger with the usual flange joint at the throughput entry end, using a sleeve coupling at the other to absorb expansion shift and misalignment if the shell does not expand uniformly. This slip-type of connection does not resist axial shift, and thus allows end thrust to be built up against the U-member at the tie-in. To relieve the welded section of this stress, three sets of lugs are mounted on the pipe at each side of the expansion joint, each pair being joined with a line which serves to limit travel outwardly, without placing obstacle against shifting of the paired ears inwardly.

The links may be removed when releasing the slip-joint sleeve, and the end thus freed for removal.

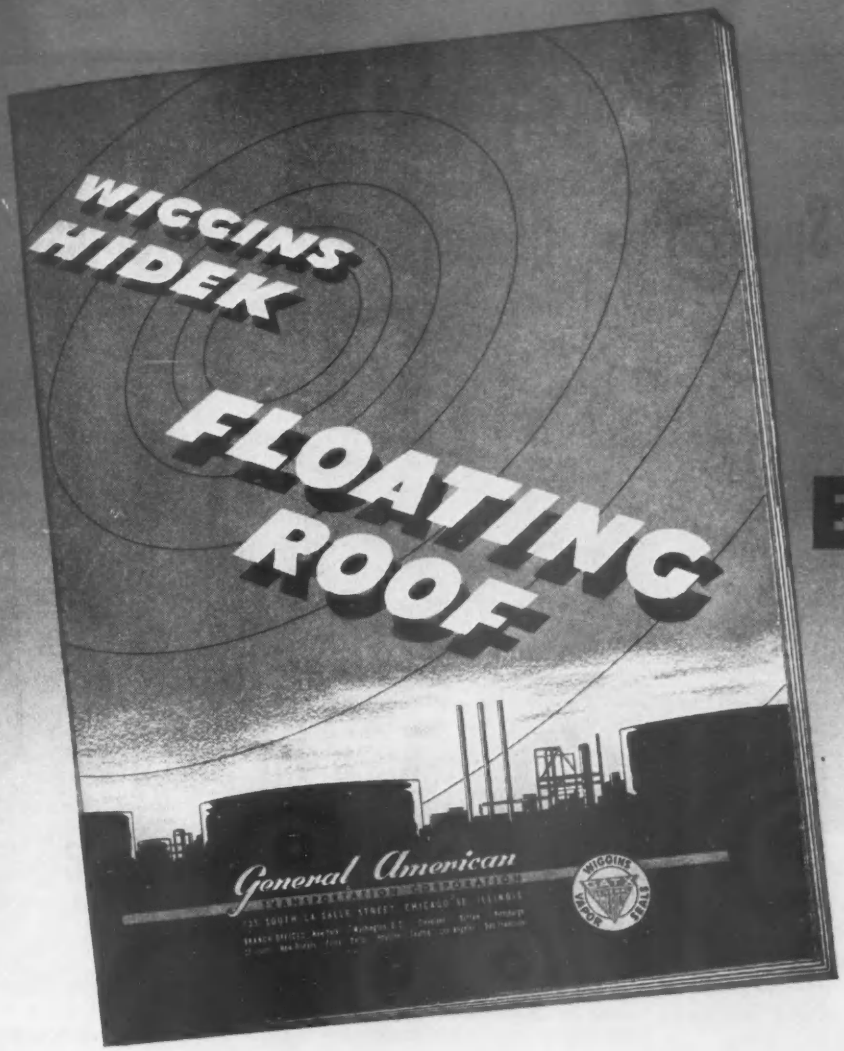
HOW TO—

Cover Openings in Engine Room Floor

Tools, small parts, and wiping rags have a habit of disappearing down into the cavities in the engine room floor when the grating around suction and discharge lines are not equipped with guards. Where pipe lines pass to conduits under the floor, and supports of cylinders and the like are surrounded by removable plates, one company keeps under-the-floor conduits clean and prevents loss of tools by attaching rims and projections to the steel floor plates.

Around the openings for pipe lines, a circular rim approximately 1½ inches high is welded to the floor plates so that matching plates will be closed tight enough to prevent sweepings from falling under the floor. Where the openings are square or rectangular, wide flat pieces of metal are welded to the edges of the floor plates so that wrenches and hammers used by maintenance men will not accidentally fall into the opening. For ease of removal when opening the conduits to inspect lines and fittings, all plates are fitted with lift holes into which are inserted hooks so that mashed fingers will not result as happens when

screwdrivers or small pinch bars are used to remove the covers.



REDUCE EVAPORATION LOSSES

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- Hidek Floating Roofs
- Lodek Floating Roofs
- Balloon Roofs
- Breather Roofs
- Dry Seal Lifter Roofs
- Dry Seal Gas Holders

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The bulletin explains fully how breathing and pumping losses are reduced to a minimum and product quality retained by:

Hermetically sealing the liquid surface with triple seal protection.

Permitting the relatively small volume of vapor intentionally trapped beneath the roof to expand without venting.

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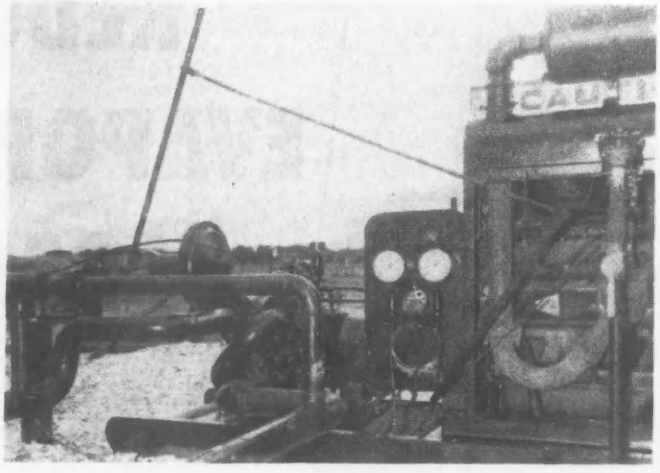
FRANCE: Etablissements Delattre & Frouard réunis, Paris

HOW TO—Regulate Engine Speed Where Discharge Pressure Varies



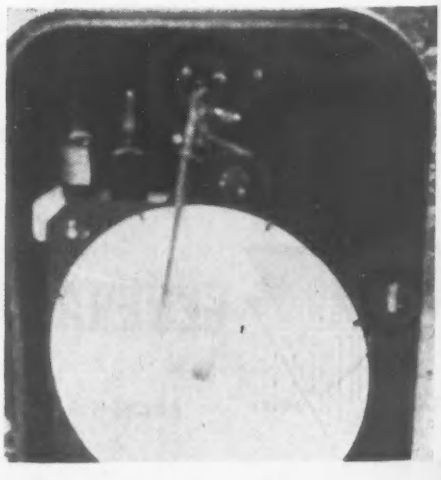
Where the discharge pressure of a pump varies from atmospheric to a high pressure, it is difficult to keep the necessary power output by means of the engine governor. One company has a pump station where the fluid is under vacuum most of the time, but at other times it needs pump pressure. By placing a check valve in the line and a bypass to which the pump is connected, the fluid will gravitate through the line when under vacuum, but pump pressure can be applied when necessary.

In order to keep the engine idling when vacuum is on the line, the diaphragm from a pressure reducing regulator was set in a horizontal position with the pressure line from the top tied into the discharge of the pump. Where the weights ordinarily hang on the shaft from the diaphragm, a connection was made to the gasoline mixture inlet on the manifold of the engine. By reducing greatly the amount of travel through an intermediate lever, the gas was turned on sufficiently to give gas to the engine when the pressure came on the discharge line.

HOW TO—

Keep Ink Bottles Inside Meter Case

Since meter cases have been weather proofed to eliminate the need for meter houses, there is no convenient place to keep the bottles containing ink for the recorder pens. One company has a small shelf in each of the meters which is made from a 3x4 inch piece of galvanized sheet metal. As shown, the metal is bent about an inch from one side and a hole drilled in the bent side to receive the screw which holds the back plate on the meter. The screw is removed and the side of the shelf slipped down between the back plate and the bar which comes out from the back of the meter. Since installing this device on their meters, a noticeable improvement could be seen in the charts since ink was always at hand for the pumper to keep the pens filled.



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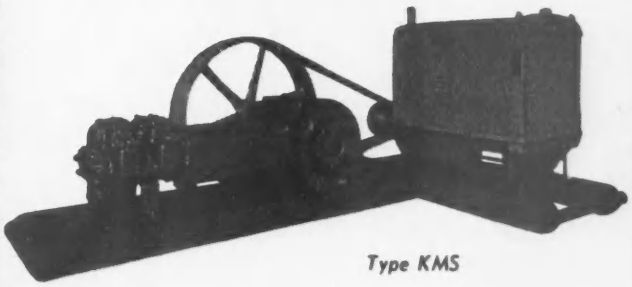

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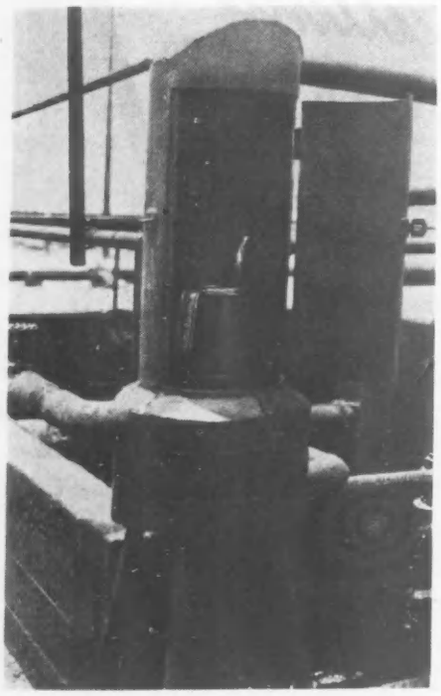
HOW TO—Make Insulated Cabinet to Keep Steam Cylinder Oil Fluid

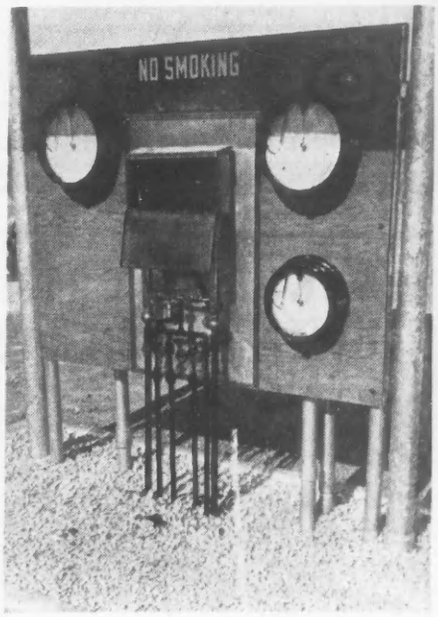


Due to the nature of the product, steam cylinder oil is always difficult to pour, particularly in cold weather and in the early morning hours of the day. To keep the lubricant fluid at all times, one company operating a large pipe line pumping and oil treating station has taken advantage of an opportunity for heating where oil heating steam lines pass near a group of steam pumps.

A four-legged stand was placed beneath a turn in the steam line to support both the line and a chamber for the measuring can in which pump lubricant is stored. Insulation was placed around the top of the support and the base of the cabinet in which the oil can is stored.

The cabinet was made from a piece of 12-inch light weight pipe having a simple welded top head and was then attached to the cover over the steam line. The door was made by cutting one side from the cabinet and attaching hinges on one side and a hasp and staple on the other. Oil is kept fluid until required and the cabinet, with a dust proof door, prevents contamination of the oil by dust and debris picked up by the wind. The convenient location of the oil can heater facilitates adding steam cylinder oil to the lubricators.

HOW TO—Remind Workers Of Fire Hazard



The edge of the parking area is the "No Smoking" limit at many pipeline stations, especially on lines handling gasolines and other high volatile products.

One company makes it easy for the relieving shift to dispose of cigarette butts at the entry to the station yard by mounting a blanked-off swage on the pipe rail at the edge of the lawn. The swage is supported on a short nipple which is blind-welded to the pipe and which carries a collar for making up the swage. A disc, welded across the small end of the swage, seals the base of the container and makes the job of emptying it simply that of unscrewing the fitting and dumping it into the track drum.

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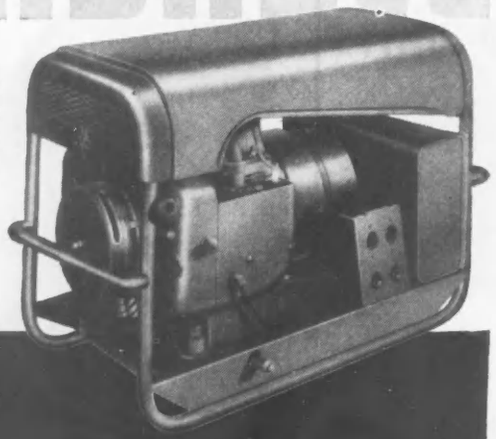

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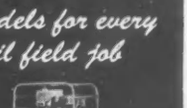

Diesel Plants: 2½ to 35KW

TAP LINE WORK in Second Phase

By GEORGE O. IVES
International Editor

WITH THE FIRST leg completed, work continues on the second stretch of the Trans-Arabian pipe line from the Persian Gulf to the Mediterranean. How the project is being accomplished is described in this article.

A section of the Trans-Arabian oil pipe line in the Persian Gulf area of Saudi Arabia. Final destination of the big "30-inch" when completed, will be Sidon in Lebanon on the Mediterranean Sea, 1070 miles away.

CONTINUED expansion in production from Saudi Arabia, principally in the Abqaiq field, makes completion of the first segment of the proposed 1067-mile Trans-Arabian pipe line of immediate benefit to the operators of this important Persian Gulf producing nation. The first 37 miles of the 30-inch line connect the Abqaiq field with Qatif, where it can route crude oil through temporary connections at Qatif to the Ras Tanura refinery, some 17 miles away.

With the first leg completed, crude oil was started moving through the line late in May and Trans-Arabian proceeded with construction on the second segment, a line to connect the Abu Hadriya field with Ras Tanura through the junction at Qatif. Shortly before August 1, construction was already in progress with sufficient pipe on hand to complete the line to Abu Hadriya and beyond. Meanwhile, no further action had been taken on steel export permits to allow shipment of additional pipe, although a decision is expected in September.

Constructed by Trans-Arabian Pipe Line Company, with International Bechtel, Incorporated, as contractors, the line is the first increment of the entire 1067-mile system. Upon completion of the entire line it will be an integral part of the system designed to move more than 300,000 barrels daily from the Persian Gulf to a Mediterranean port six miles south of Sidon in Lebanon. Although final ratification of right-of-ways has not been made by the Syrian government, it is possible that the political situation may allow final signatures by the time work on the line, with continued steel deliveries, has reached a point where decision must be made as to whether the original route is to be followed, or whether it may be more feasible to build to another port or use another route. A number of possibilities have been suggested, although perhaps not seriously considered as yet by the operators. The first 800 miles of the line could be built before it would be necessary to change the route so as to reach a terminal south of Suez or perhaps make water-crossings which would take the line into Egypt. At any rate, the building continues toward the point near Abu Hadriya. This field was discovered in 1940 but has never been produced, since no outlet was available. Development was concentrated farther to the south where production is reached at a lesser depth and is only a relatively short distance from the company's refining and shipping facilities.

Abqaiq, the starting point of the new line, is one of the Arabian American Oil Company's principal producing fields in Saudi Arabia. The first flow of oil through the line was from Abqaiq's Trap

Work on the Trans-Arabian pipe line goes forward. Neither desert heat nor sand storms have stopped construction of this vital artery. When completed, the line will provide fuel for European recovery, and ease the drain on American supplies.

Setting No. 2, a flow station 7½ miles north of the main Abqaiq camp and center of producing facilities. Qatif, 37 miles north of Trap Setting No. 2,, is a smaller field from which point runs a 20-inch and 22-inch line 17 miles to Ras Tanura.

Installation of the line was expedited so that it could be placed into immediate service to augment the supply of crude oil to the Ras Tanura refinery and the crude oil loading terminal. In this service the line is therefore a combination of 30, 20, and 22-inch from Trap Setting No. 2, capable of delivering as much as 330,000 barrels a day. As previously indicated, the line will eventually be incorporated into the 30-31-inch system to the Mediterranean with Abqaiq as the principal known source of supply. Running through country typical of much of Saudi Arabia and posing a variety of construction problems, the line has served as a "guinea pig" for construction of the remainder of main line to the Mediterranean..

Description of Country

The area between Abqaiq and Qatif is largely sand dune country, such as is to be encountered in a good part of the remainder of the route. It is unvegetated save for sparse shrubs and an occasional battered date palm, underlaid by coarse, brittle marine limestone and interspersed with salt-encrusted mud flats called "subkhas." In places the sand dunes rise to a height of 40 feet or more, moving slowly to the southeast with the prevailing northwest winds. Measurements taken by the Arabian American Oil Company indicate that dunes 20 feet in height move about 50 feet per year with the rate of movement roughly inversely proportional to the height of the dune face.

Owing to the unusual terrain conditions and the large diameter of the thin-wall pipe, the engineers and pipe line construction men were presented with a variety of new and unusual design and construction problems. Burial of the line in the orthodox manner was the desired type of construction. This was unfeasible in the highly corrosive subkhas and in areas in which hard limestone lay close to the surface. Burial in the subkha areas not only seemed inadvisable because of the serious corrosion problem, but because it would have involved the imposing problem of de-watering the ditch to keep the empty pipe from floating. Burial in the areas in which rock lay at or near the surface presented no new problem, but was deemed to be inordinately expensive. Accordingly, in such areas the line was designed to be laid above ground, on concrete supports in the rocky stable areas and on steel bents through the subkhas. Of the 37 miles from Trap Setting No. 2 to Qatif, 12½ miles were laid above ground on concrete supports, 12 miles above ground on steel bents, and the remaining 12 miles were buried. The steel bents, consisting of two eight-inch or ten-inch "H" beam piles on six-foot centers driven to depths varying from 10 to 20 feet, were capped with pipe cut-offs and were used in lieu of wood piling specified for the job but not available in time. Bents and concrete supports were spaced at 66 foot intervals.

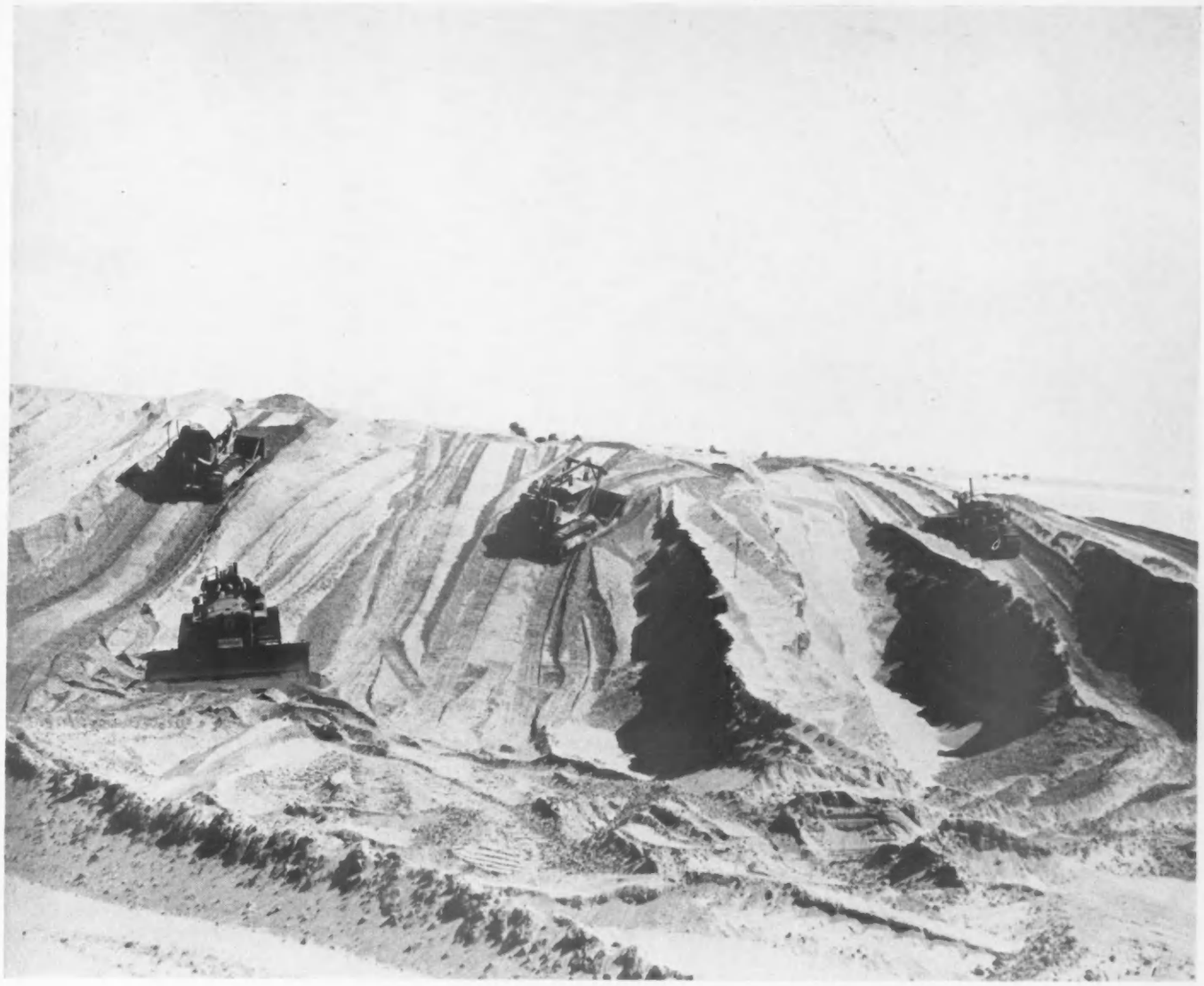
Owing to the large diameter of the line, to the thin wall pipe (¼ inch and 5/16 inch), and to the possibility that portions of the line above ground would be covered by sand from time to time, the designers decided against the use of any type of expansion bend for the above-ground sections and specified instead that the line should be fully restrained. This means that supports must be set to line and grade and that horizontal and vertical changes of direction beyond a minimum of about one degree must be anchored in some manner, the nature and size of anchor depending upon the magnitude of the direction change.

Restrained above-ground construction represents a radical departure from orthodox methods of laying oil or gas pipe lines, although it has been used on several previous occasions in construction of large diameter thin wall above-ground water lines. The application of this principle to oil pipe line construction has naturally been a highly controversial issue, but the completion of the first 25 miles of this type of line forces the conclusion that restrained construction has a very definite place in the construction of future large diameter lines in areas where burial is difficult, from the standpoints of economy, reduced corrosion and ease of maintenance. The special problems involved in laying of above-ground restrained line have led some to term it "a structure" rather than just a pipe line.

Pipe Fabrication

The pipe was fabricated near Los Angeles from steel plate, ½ inch to ⅜ inch in thickness and 31½ feet in length. The sheets were trimmed, formed into cylinders in giant rolls, automatically welded longitudinally inside and out, and finally formed and expanded hydraulically beyond the yield point to cold work the metal and raise the yield point. A minimum specification of 52,000 psi circumferential yield strength was adhered to. The pipe was tested, after cold working, to 90 percent of yield and will be operated at a maximum of 65 percent of yield. The completed joints, beveled for field welding, averaged slightly more than 31 feet in length. Equal quantities of 30 inch and 31 inch diameter pipe were fabricated, to be nested for shipment as an economy measure. All of the 31 inch diameter pipe was of ¼-inch wall thickness, but the 30-inch pipe is being fabricated in roughly equal quantities of ¼-inch, 5/16-inch, and ⅜-inch wall thickness. The 30-inch diameter pipe only was used in the Abqaiq-Qatif section, 31 miles of this being ¼-inch wall thickness and the remaining 5/16-inch.

The port of entry for the bulk of materials for the pipe line was Ras el Misha'ab, a new port and camp constructed on the shore of the Persian Gulf, 175 miles northwest of Qatif and just south of the border between Saudi Arabia and the Kuwait Neutral Zone. This location was selected for a port for a number of reasons: (1) the port at Ras Tanura, the only other convenient port for ocean-going vessels in the area, was badly congested, (2) average length of truck haul would be materially reduced; (3) terrain between Ras el Misha'ab and most points on the line will permit use of harder tired vehicles than those which are necessary in the sandy areas;



Digging out a right-of-way for the big 30-inch Trans-Arabian pipe line, these bulldozers are carving a Saudi Arabian sand dune 30 miles south of Ras Tanura near the Persian Gulf.

and (4) Ras el Misha'ab was one of the few locations along the western shore of the Persian Gulf where an ocean-going vessel could approach within a reasonable distance from shore.

The first of a series of pipe ships, a Liberty, 43 days out of Long Beach across the Pacific, dropped anchor off Ras el Misha'ab on December 28, 1947. It carried a little more than five miles of pipe, equally divided between 30 inch and 31 inch. The pipe was moved from ship to a temporary earth-fill causeway by barge, although since May pipe has been moved by an overhead cableway known as the "skyhook" from a sea island to the pipe stockpile.

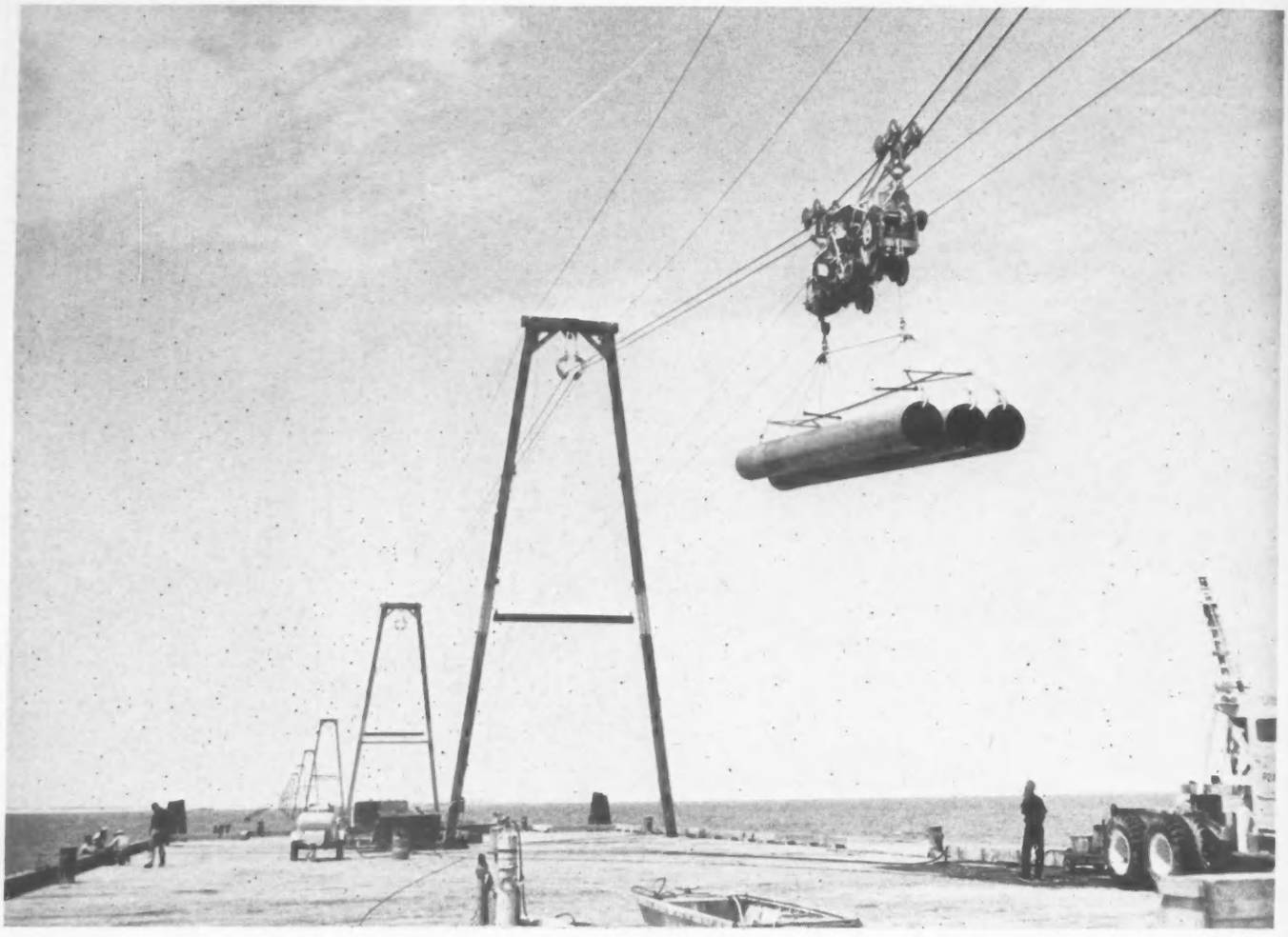
By January 10, 1948, the first of four units for denesting and triple jointing or quadruple jointing of pipe was ready for operation, and work of welding three joints of 30-inch pipe into units about 93 feet in length began. The welding was by the automatic shield arc process, the machine used having been especially designed and built for this work by the Westinghouse Company in cooperation with Bechtel engineers. The key to the success of the operation was a mechanical line-up clamp which permitted alignment of pipe walls within 1/64-inch and which rotated with the pipe over a stationary water-cooled copper backup shoe while the weld was made. Each of the four automatic machines is capable of an average of four completed welds per hour.

Transport Problems

Hauling of heavy loads in Saudi Arabia, particularly in the sandy areas, presents transport problems rarely encountered in other parts of the world. Trucks must be especially designed for desert driving with large capacity cooling systems and large low-pressure tires. For the hauling of pipe and heavy equipment, the Abqaiq-Qatif pipe line constructors used a fleet of thirty 4x6 and 6x6 trucks, equipped with 14x20 8, 10, or 12 ply tires and powered by 300 horsepower gasoline engines. The pipe trucks were equipped with fifth wheels and dual axle dollies. Nine or ten 93-feet lengths were carried with loads varying from 33 to 42 tons. Average loaded speeds of 15 miles per hour were maintained on the haul from Ras el Misha'ab to the line, owing to heavy sand traversed over a portion of the route and to mud in the subkhas. Pipe was unloaded along the right-of-way by D-8 sideboom tractors, two of them handling each 93-feet unit.

The Abqaiq-Qatif pipe line was built from the northerly end where a camp was established in February. Driving of steel piles for above-ground sections was started on February 10, and the first load of pipe was strung on the line on February 16. Field welding was started on February 25 and the 37 miles between Qatif and Abqaiq Trap Setting No. 2 were welded by April 22. Following completion of hydrostatic tests, oil was started through the line on May 5.

Clearing of the right-of-way required the movement of large quantities of sand through the dune areas, and all available earth moving equipment, including bulldozers, carryalls, and draglines, was kept busy. As much as 20,000 yards of sand



Riding on cables through the air for three miles from the Persian Gulf at Ras el Mishaab, Saudi Arabia, this man-operated skyhook carries tons of steel pipe from vessel to supply base. Operator communicates with shore office by means of two-way radio.

were moved per day in two ten-hour shifts.

Ditching proved to be generally difficult in buried sections of the line. In sections where a ditching machine was used, trouble was experienced with sloughing of sand into the trench. In some areas in which use of the ditching machine seemed to be indicated, the machine was able to travel no more than a few hundred feet without encountering ledges of hard rock which prevented further progress. Numerous attempts were made in the rocky areas to use a 20-ton giant ripper pulled by four to six tractors to break up the rock in the ditch. Use of the ripper was partly successful in scattered short sections where the rock was soft or laminated, but even in these sections it was difficult to keep the ripper on a straight course, and a crooked ditch requiring considerable dressing-up resulted. For the most part the rock was too hard for the ripper and it was necessary to resort to blasting, followed by a backhoe. The greatest difficulty in attempting to make a ditch in this area arose from the fact that the subsurface conditions were so non-uniform. Attempts to use either the ditcher or the rooter frequently failed after no more than a few yards progress, and it became necessary to use a combination of ditching machine, rooter, backhoe, and blasting, with carryalls in the sandy areas, to complete the ditch.

Protection Against Corrosion

Protection of buried sections of the line against corrosion is achieved by a field applied coat-and-wrap job supplemented by cathodic protection using magnesium anodes. The coating consists of an application of petrolastic asphalt having a pour point of 210° F. followed by a wrap of glass floss and a final flood coat of asphalt. The occasional subkha, having very low resistant soil, constitutes an ideal ground bed for the anodes, and preliminary tests indicate that buried sections of as much as seven miles may be adequately protected by a cluster of no more than two 17-pound anodes. In rocky areas added protection is provided to the pipe treatment by lining the ditch with sheets of asphalt-impregnated asbestos padding, three feet wide and 3/16-inch thick.

Under favorable conditions, field welds were made at an average of one every 30 minutes per welder. Excellent welding quality was maintained throughout by the use of gamma-ray weld inspection and control. Using an electrically driven internal line-up clamp with two stringer bead men, the complete line-up and stringer bead operation required about four minutes per joint.

As might be expected, construction of the Abqaiq-Qatif line was attended by more than the usual amount of unfavorable weather. Between March 1 and April 3, a total of 10½ working days were lost owing to heavy rains or high winds and sandstorms.

Following completion of the line from Qatif to Abqaiq Trap Setting No. 2, the pipe line crew continued with extension of the line to the main Abqaiq producing area 7½ miles farther south. Before leaving this area, a parallel 22-inch line 7½ miles long was also built for the Arabian American Oil Company. The crew is now laying pipe on the next increment of Tapline, from Qatif 110 miles northwest to the vicinity of Abu Hadriya, another of Aramco's large proven oil fields. As of July 24, 19 miles of this section had been laid.

Once the entire line from Abqaiq to the Mediterranean has been completed, oil from the Abqaiq, Qatif, and Abu Hadriya fields may be moved to the western terminal, and with the flexibility provided by the connection at Qatif it will also be possible to move a portion of Abqaiq oil in the 30-inch line to Ras Tanura, making up the withdrawal at Abu Hadriya.

A copy of this picture suitable for framing will be sent on request.

ROBERT YARNALL RICHIE

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Prospecting for Oil in the Northwest Territories

By

JOHN M. PARKER

THE CURRENT exploration boom in Northwestern Canada has made this region of special interest to oil men. In this article the author discusses the history of the region, its climate, geologic structure, and potentialities as an oil-producing area.

Standard Oil Company (N. J.) photo by Corsini

FIGURE 1. Wintertime surveying in the Norman Wells area, N. W. T., Canada.

FOR many years, men have dreamed of finding oil in the immense petroliferous province known as the Mackenize River Basin, which lies in the Northwest Territories of Canada. It remained for the impact of World War II and the increased demand for petroleum products following the war to provide the incentive for oil exploration on a large scale in this remote land of the midnight sun.

Through the central part of this large regional basin flows the Mackenzie River—nearly a thousand miles from its origin at the west end of Great Slave Lake to its 100-mile long delta at the Arctic Ocean. The average width of the Mackenzie is one mile, the gradient averages six inches per mile, current speed varies from three to six miles per hour, and average main channel depths range from twenty to thirty feet. At Norman Wells, which is in the central part of the basin, the river is four miles wide.

The Mackenzie Basin is a collection of many small topographic and and structural basins separated by structural mountain uplifts. The basin is flanked on the east by the Canadian shield complex of pre-Cambrian igneous and metamorphic rocks; on the south by a

About the Author

John M. Parker's first field geological experience was "running the gun" on a field party in Wyoming for the Wyoming Geological Survey in 1938. After graduating from Kansas State College in 1941 with a B.Sc. in geology, he did field geology for the Kansas Highway Commission. He next worked as a geologist on the Alaska Highway, then for the Imperial Oil Company, and then for Stanolind Oil and Gas Company. He is now located in Casper, Wyo., as geophysical coordinator for the Stanolind Rocky Mountain division.

low relief structural saddle, which connects the Mackenzie Mountains with the pre-Cambrian shield; and on the west by the Mackenzie Mountains. To the north, the structural basin extends far out into the Arctic Ocean. (Figure 1.)

Most of the basin area consists of flat, poorly drained, muskeg type country, dotted with thounsands of small lakes and covered with a dense growth of black spruce and other typical subarctic plants. The surface of the land has changed very little since the retreat of the final glaciers of the Ice Age dumped a veneer of sand and gravel on all of the flat areas, sculpted and planed off the lower mountain ranges, and created the numerous lakes. (Figure 4.)

The "tree line" (the imaginary boundary, north of which no trees grow) sweeps far north of the Arctic Circle in the Mackenzie country to the delta of the river, and even a good portion of the delta is covered by a growth of scrub willows. Thus, timber line in the area ranges from a few feet above sea level at the delta area to three or four thousand feet above sea level at the southern boundry of the Northwest Territories. The many structural mountain ranges, which lie within the basin proper, have fairly dense covers of spruce, birch, and aspen up to the timber line.

Climate

Winter and summer seasons are effectively defined by the freezeup of rivers and lakes in the autumn and by the breakup of the ice in the spring. Using only two seasonal subdivisions, winter and summer, and defining summer as the period when canoes and larger boats can be used, summer begins about June 1 and ends about October 15.

During June, July, and August, there is almost continuous daylight, 24 hours a day, so that if one is ambitious, he can do six months of work in three months time. Temperatures in the summer often rise as high as 70 degrees, and at the lower elevations there is a frost-free season long enough that vegetable gardens can be grown successfully a hundred miles north of the Arctic Circle. The vegetables are, of course, ambitious, growing all of the time the sun shines, so that frost-free period of 50 days in this sub-arctic land is comparable to a frost-free period of about 80 days at lower latitudes.

Travel across country in the summer months is extremely difficult because of lakes, swamps, mountain ranges, and mosquitoes (in this country, a physical barrier more exhausting than crossing a continuous series of 12,000 foot mountain ranges).

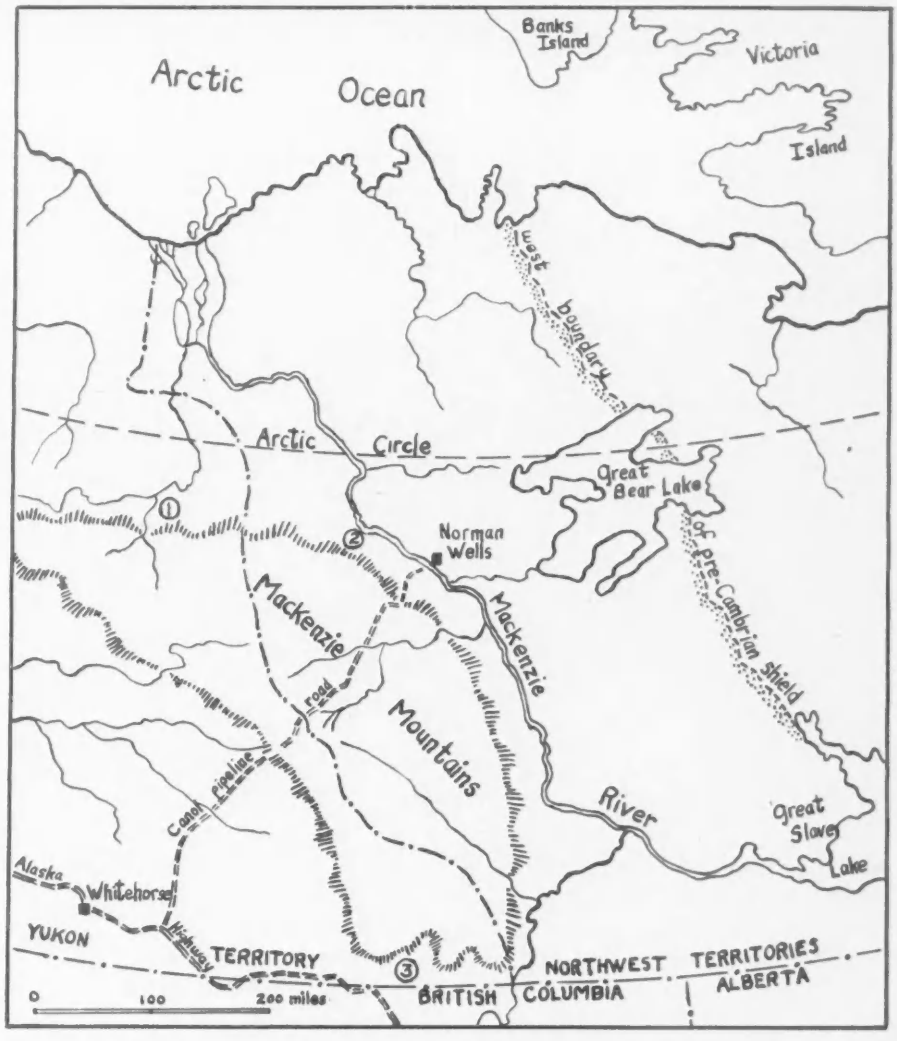


FIGURE 2. Index map of the Mackenzie Basin. The locations of the stratigraphic sections shown in Figure 3 are marked on this map.

In the winter, if one is prepared to travel by snowshoes, toboggan and dog teams, living in continuous sub-zero temperatures with only a few hours of daylight each day, all of the flat swampy country can be traversed quite easily. The flat country is covered with about four feet of snow all winter. It is not unusual for the temperature to drop to -20° or -30° F. and stay there for from one to three months at a time. However, the minimum temperatures are no lower than those encountered nearly every winter in North Dakota, Montana, and Wyoming (-40° to -60° F.).

From the above description of the geography, it is easy to understand why exploration has been largely confined to the summertime, with travel by boats or canoes along the Mackenzie and its larger branches.

Petroleum Exploration to Date

The first exploration trip of any kind by white men into this country was made by Sir Alexander Mackenzie in 1789 when he went down the river, which now bears his name, to the Arctic coast and returned to civilization (Winnipeg, Manitoba) in one summer season. The Indians, who lived in this country, and the furtrappers, traders, and missionaries who followed them made use of the crude oil obtained from seeps along the Mackenzie River for caulking, lubricating, and medicinal purposes.

The first geological exploration of the region was made by C. A. McConnell in 1887-88, for the Canadian Geological Survey. Between 1887 and 1942, the Canadian Geological Survey sponsored about a dozen exploration trips into the Mackenzie country, while oil companies sent about the same number.

The first petroleum geology was done by Dr. T. O. Bosworth, who made a voyage down the Mackenzie in 1911 on one of the Hudson Bay Company's steamboats. Bosworth, a consulting geologist from London, had been retained by a group of farsighted Calgary, Alberta, oil men. Bosworth was forced to do much of his geology from the deck of the steamboat; however, he checked and expanded a little on the earlier geologic mapping of the banks of the Mackenzie and he staked claims on what

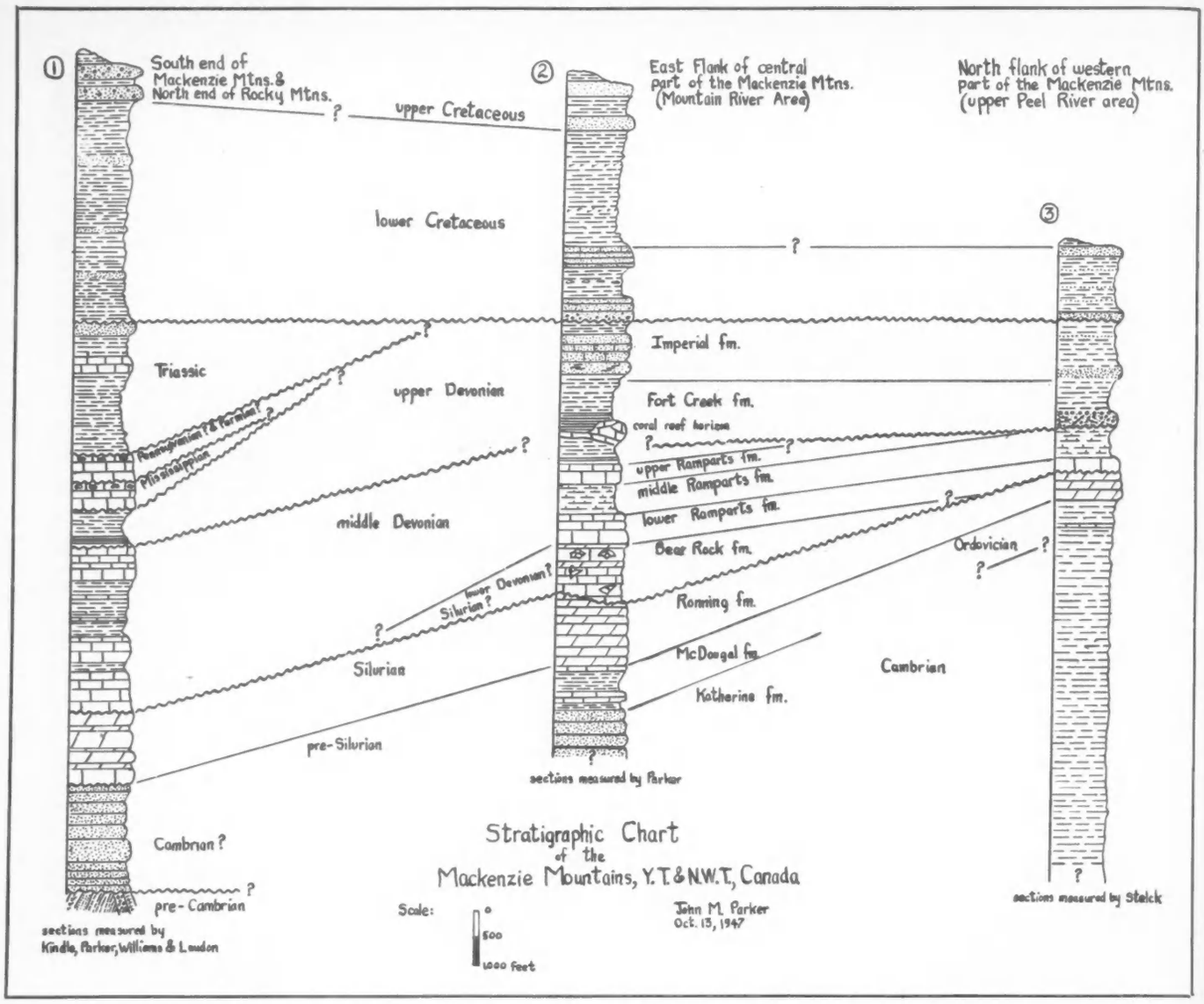


FIGURE 3. Stratigraphic chart of the western part of the Mackenzie Basin and the eastern part of the Mackenzie Mountains.

is now the site of the Norman Wells oil field, where several large oil seeps had been known for many years. No drilling was undertaken on these claims by the Calgary group and after the first World War they sold their claims to the Imperial Oil Company, Ltd.

Imperial hired Theodore A. Link, a young geologist just out of school in 1919, and sent him to the Bosworth oil claim area. Link spent three summers (1919-21) doing field work in the central part of the Mackenzie Basin, working out from the Norman Wells area. His field work in 1919 was followed by the drilling of the discovery well of the Norman Wells pool in 1920. The well was located at the site of the seepages where Bosworth had staked his claims. Oil was encountered from the grass roots down, and the well was finally completed, flowing by heads from Devonian shale, at a total depth of 783 feet.

Link was thus the first petroleum geologist to work in the country during the so-called modern era of oil finding. At the end of his third summer, Link was away ahead of the crowd when he hired one of the first bush pilots to fly him over part of the area in which he had worked. Although part of the area was covered by a smoke haze, and the trip ended in a crash landing, Link obtained that overall view and geologic-geographic understanding of which all field geologists now avail themselves when they use aerial photos or make inspection flights over an area.

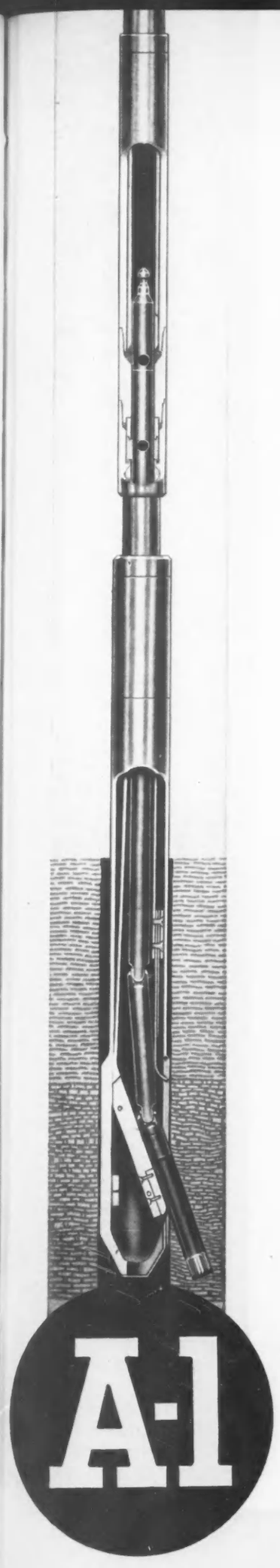
Other Wells Drilled

Between 1920 and 1942, Imperial drilled three other wells, all within a mile of the discovery well. Imperial built a small refinery at the Norman Wells field (named after Fort Norman, which is a Royal Canadian Mounted Police, and Hudson Bay Company's post located seventy miles upstream from the oil wells) to supply the local fuel needs of trappers, prospectors, and miners.

During the same period, Imperial drilled three outpost or wildcat wells within ten miles of the discovery well, all three of which were dry. So by 1941, seven holes—four producing and three dry—all in an area ten miles long and four miles wide, comprised the total exploratory effort in an oil favorable sedimentary basin that is 700 miles long and from 100 to 200 miles wide.

The Canol Project, initiated in 1942 to develop the Norman Wells field and pipe the oil to Whitehorse, Y. T., as a part of the U. S. Army's plan to supply oil to Alaska, is a familiar story to most oil men. The nature of the oil field could not be determined from the original four wells or the limited surface outcrops in the vinicity. The whys and wherefores of the oil, its extent, and the reserves were all unknown until drilling was inaugurated under Canol direction.

The Canol drilling showed that the accumulation in the Norman Wells field is in a porous Upper Devonian limestone reef resting on regionally dipping monoclinal beds. Accumulation is controlled by the areal extent of the reef and by



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the varying porosities developed in different parts of the reef. No reverse dips or even a nosing is present in the beds, which lie above and below the oil-bearing reef. The proven area in the Norman Wells field is about 4300 acres, total recoverable oil is estimated to be about 35 million barrels. Drilling is cheap, wells are from 1500 to 2000 feet deep, and most of the digging is in soft shale.

During the time that Imperial was developing the Norman Wells field under Canol direction, 12 surface parties were sent into the field under Imperial-Canol direction. In addition, a photogrammetric and office staff was maintained to assist in the geological exploration. The purpose of this exploratory effort was to develop additional sources of oil for the Canol pipeline because the potentialities of the Norman Wells field were still unknown and the U. S. Army had upped its original estimate of daily crude deliveries needed at the terminal refinery in Whitehorse.

These 12 surface parties covered a tremendous area in reconnaissance during one field season and, as a result of their work, the general stratigraphy and structure of most of the Mackenzie Basin was worked out.

One seismograph crew was put into operation under Imperial-Canol direction. The crew worked in a restricted area close to the Norman Wells field and to the river.

Four wildcats were drilled by Canol, all of which were near the Mackenzie River. Two were drilled on one surface anticlinal structure, the third on another surface fold, and the fourth on a combination surface and seismic anticlinal structure. All were dry. Since the end of the Canol operations, Imperial has drilled about 20 wildcats in the Mackenzie asin—all of which have been dry. Because drilling of some of these wells was based on closeness to the river rather than on the excellence of the prospect, the number of dry holes is not as discouraging as it sounds. However, some first-class anticlinal prospects were drilled and they are still very dry.

Following the completion of the geological exploration carried out by the Canol project, Imperial did further work of its own, covered most of the Mackenzie province not already worked with reconnaissance geology, and did detailed work on some of the more accessible first-class structures. Imperial has done gravity work in selected areas during the last three-year period and has also done a limited amount of seismic work. Shell and Socony-Vacuum have had field parties in the area within the last three years.

The Geologic Section

The probable average thickness of the sedimentary section in the central part of the Mackenzie Basin is 12,000 feet. Assuming that the eastern part of the basin has less favorable oil prospects (the portion of the basin in which the sedimentary cover over the basement ranges from a feather edge at the point of overlap on the pre-Cambrian shield to a line 100 miles west of the shield where the sediments may total 3000 feet—see Figure 2), the remainder of the basin, going west to the Mackenzie Mountain front, still has an average width of about 100 miles. Cambrian, Ordovician, Silurian, Devonian, and Cretaceous rocks are present in nearly all parts of the basin, and Mississippian, Pennsylvanian, Permian, and possibly Triassic rocks are present at both the northwest and southwest corners of the regional basin. There are two small Tertiary (Eocene?) basins in the Mackenzie area with a probable maximum thickness of 2000 feet of Tertiary.

Possible source rocks are present in the Cambrian, Ordovician, Middle Devonian, Upper Devonian, Lower Cretaceous, Upper Cretaceous, and Eocene. Reservoir rock possibilities can be classed as follows, according to the present limited information: Cambrian and Ordovician—poor; Silurian—fair to good; middle Devonian—fair to good; upper Devonian — good; Carboniferous —fair; Lower Cretaceous—good; Upper Cretaceous—good; Eocene—poor.

The most outstanding reservoir rocks (which, incidentally, occur in parts of the section in which source rocks are also present) are the limestones and dolomites of the Bear Rock formation (of Devonian or Silurian age?), the coral reef limestones of Upper Devonian age, the Imperial formation sandstones of Upper Devonian age, and the basal sandstones of the Lower Cretaceous. Figure 3 shows the details of the sedimentary section in the southern, middle and northern parts of the front range of the Mackenzie Mountains.

No angularity of beds can be observed at the contact of the Lower Cretaceous with beds of Devonian age, although the stratigraphic position of this unconformity may vary hundreds of feet over a distance of a few miles. Thus, in general, structure mapped in the Cretaceous will reflect older structure.

Oil Exploration Methods

The fundamental sedimentary and structural features of this province can be obtained by the usual methods of surface geology. However, since the difficulties of climate, terrain, and accessibility are so great, the use of photogeology is a "must" in this area if economical, accurate, and speedy geological interpretation is desired. Field geology in this area is ninety percent transportation and keeping alive, and ten percent geology.

The Mackenzie River and the larger streams and lakes can be worked from canoes or shallow draught motor boats or cruisers. The easiest way to work the more remote areas is the method used by the geologists working on the Canol project. Aerial photos of the area to be worked are first examined and interpreted (for routes of travel as well as for geology), and then an aerial reconnaissance flight is made at which time the final decision is made as to the route of travel and the canoe portages which will be necessary between lakes or around rapids. Then the field party of two to four men with their food supply, camping equipment, surveying equipment, and canoes are flown by pontoon plane to the lake or river, which is closest to the point at which the party is to begin work. The party chief has estimated the amount of time they need to spend traversing the area and has set a rendezvous date with the airplane pilot to be kept at a place where the plane can land at the other end of the area.

In working a river valley, the party begins at the upstream end of the area, if possible, so that all their canoeing will be downstream. In mountainous to semi-mountainous country, a two-man canoe party can cover in four weeks by reconnaissance methods about a 100-mile river traverse, assuming that there are outcrops along most of the traverse, that the party has aerial photos, and that total portaging time is not more than one week. The distance back from the river on both sides, which could be covered in this short a trip, would vary from one to five miles depending upon the complexity of the geology, the amount of timber (which would hinder photo-interpretation), and the ruggedness of the topography.

Subsurface Geology

One of the big challenges facing geologists in the Mackenzie Basin is the probable presence of numerous coral reefs similar to the producing reef at the Norman Wells field, which are buried under younger Devonian and Cretaceous sediments and which do not have numerous and prominent seepages to point out the possible oil pool at depth.

A beginning in solving this problem can be made by constructing detailed

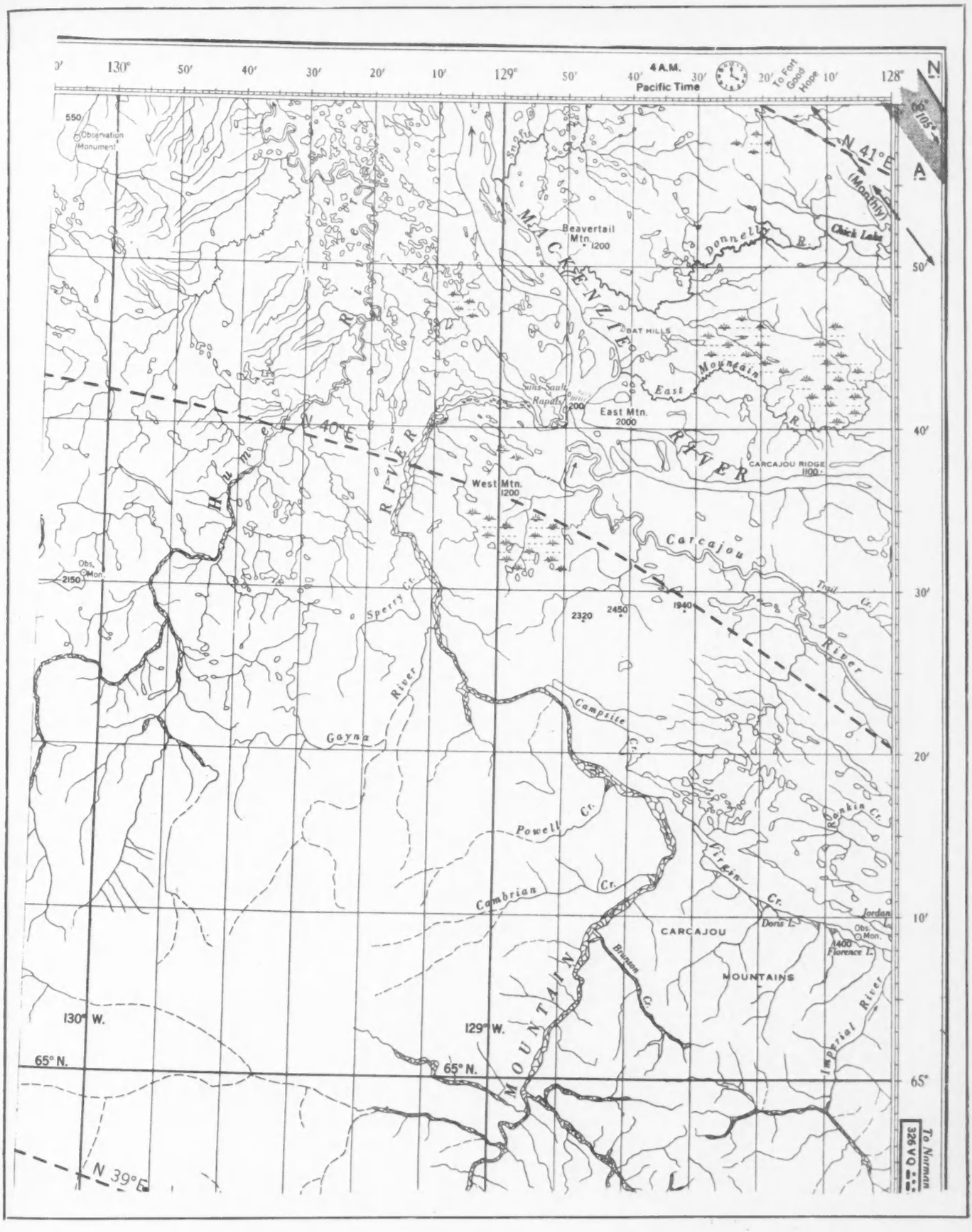

FIGURE 4. Map of a portion of the Mackenzie Basin (prepared by Canada Hydrographic and Map Service: NE portion of Ogilvie Range sheet, scale: one inch—8 miles). The Mackenzie Mountain front is easily identified by the abrupt change from flat muskeg country shown on the map by the numerous lakes and meandering streams to the mountainous country where there are very few lakes, and the streams have steep gradients as shown by the braided channels. The portion of the map in which the stream courses are shown by dashed lines is unexplored and no aerial photographs are available. Carcajou Ridge, East and West Mountains, the Bat Hills, and Beavertail Mountain are structural mountains along the Mackenzie River that are in the basin proper and are surrounded by structural basins whose surface expression is muskeg country. Elevations are shown in feet above sea level at points where control has been obtained.

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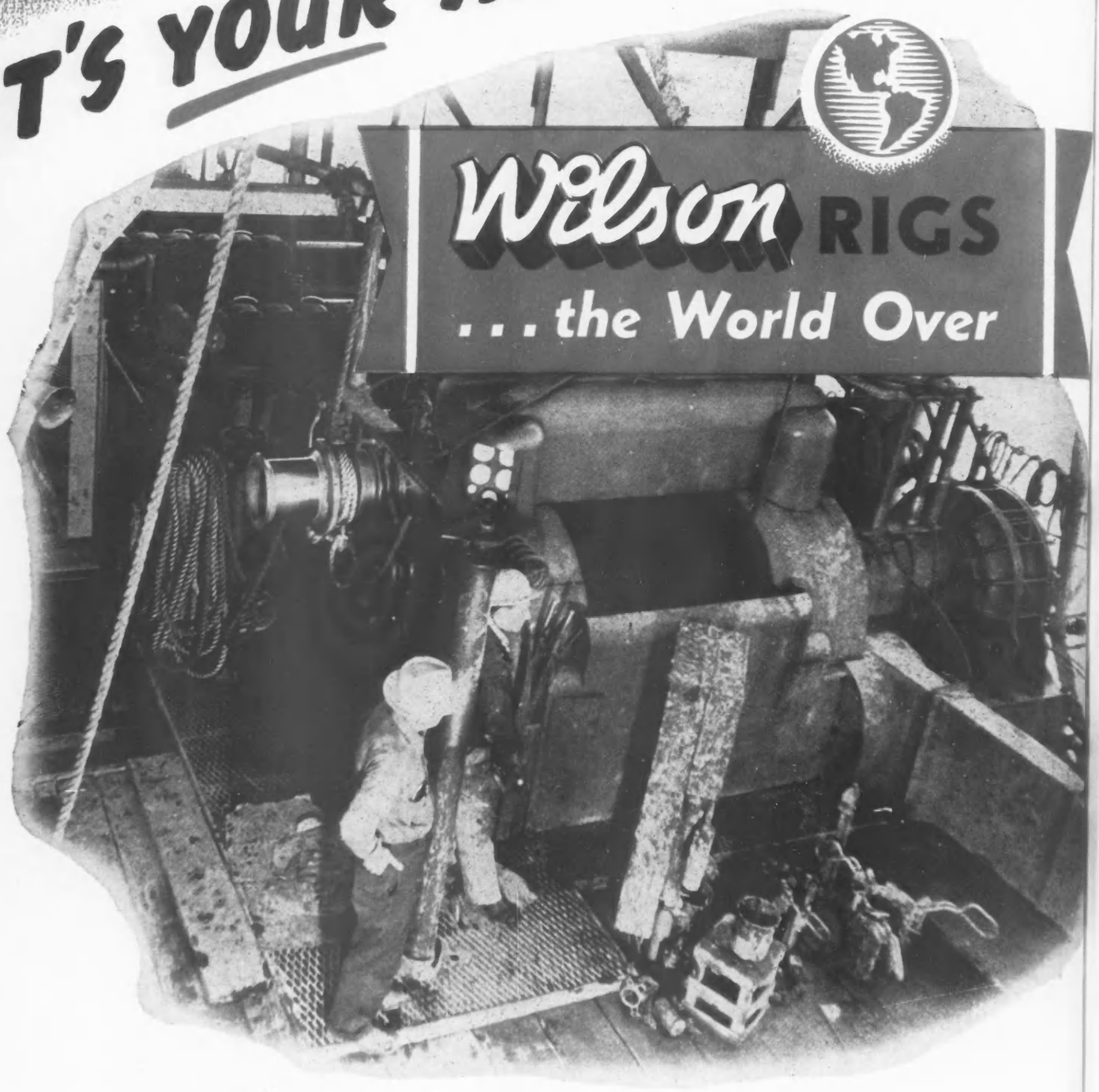

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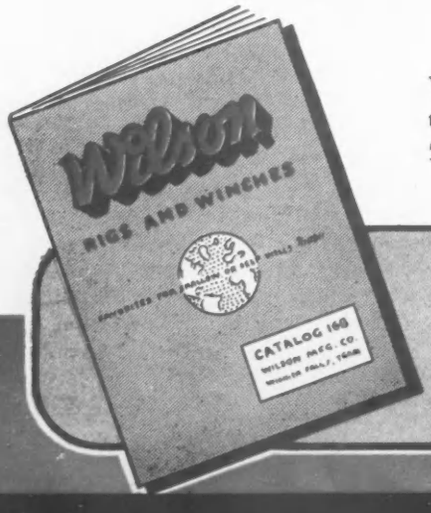

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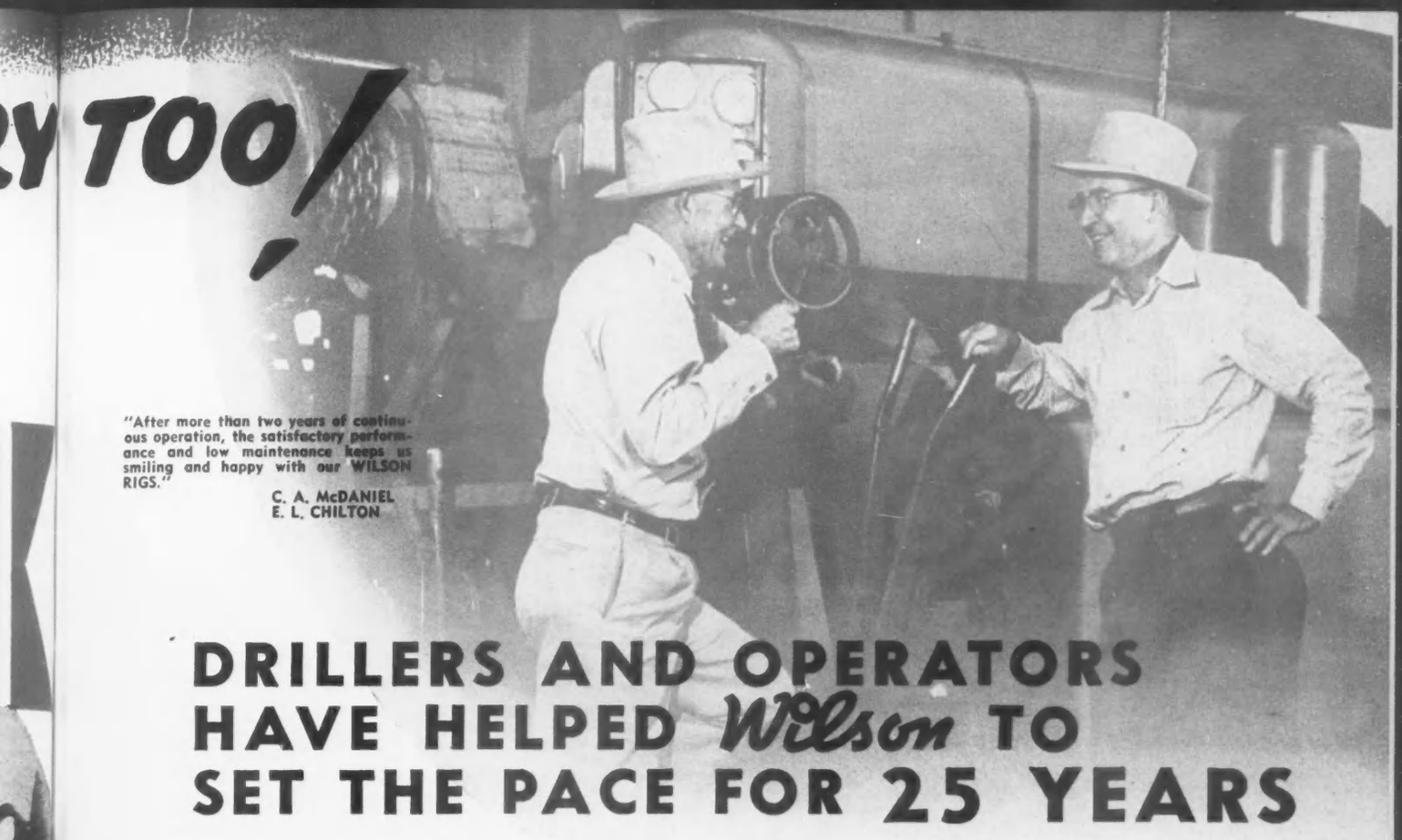

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paleo-geographic maps based on all available surface information plus the meager information from wells drilled to date. The reconstruction of the Devonian seaways, highlands, and facies boundaries is in itself a difficult task, and when one considers that one must theorize on the growth of one reef zone, which must be properly situated to receive and hold an oil accumulation, it is a real job.

Other major subsurface problems to be solved are:

1. The general problem of mapping structure in all of the muskeg basins where there are no surface outcrops.

2. The distribution and character of the basal Lower Cretaceous sands and the corollary problem of mapping the structural and stratigraphic position of the Lower Cretaceous - Devonian unconformity surface.

3. The distribution and character of the Bear Rock formation, (Devonian or Silurian?) with particular attention to porosity and permeability of the Bear Rock limestones and dolomites, and the finding of a simultaneous occurrence of a favorable Bear Rock section with good source rocks.

4. The extent and character of the Upper Devonian Imperial formation sandstones, and the tying in of this study with regional and local structure.

Solving the Subsurface Geology

The complexity of the pattern of surface folds mapped to date points to a very active basement complex during the Laramide period of orogenies. This condition, coupled with the presence of a relatively shallow sedimentary section, makes the area suitable for regional magnetic reconnaissance. The airborne magnetometer method would be the only practical way to cover the area.

In this province, it is probable that gravity coverage should be restricted to local detailed problems because of the difficulty and expense involved in obtaining a complete reconnaissance picture, which could be used to show "structural grain." Detailed gravity work along coral reef zone trends, which have been worked out from paleo-geographic studies, may be the solution to the problem of actually pinning down one reef. The Bear Rock formation locally grades into and/or includes a thick series of evaporites, which sections and their geographic extent would have to be taken into account before initiation of any gravity program. Gravity work could be done most efficiently in the summer season.

The Seismic Method

As with the gravity meter, only much more so, seismograph operations would be restricted to the checking of established surface or subsurface pictures, which need refinement. Seismic profiling along the Mackenzie and a few of the largest tributaries, using motor cruisers and barges, could be done in the summertime. However, it is probable that many seismic programs would have to be effected in the winter. During the winter season, between freezeup and breakup, with a completely winterized crew, access can be had to almost any area and patterns can be shot where needed. All equipment must be sleigh-mounted with large tractors for power units, and with bulldozer-equipped tractor to make roadways through timber and deep snow. A separate steam boiler or other heating unit is essential to efficient drilling operations.

One unique problem encountered in the area is the presence of the permafrost soil or rock layer. The soil, or bedrock, in this area is frozen the year round to depths ranging from 20 to 80 feet except for the upper one to three feet of soil, which thaws out in the summertime. Therefore, seismic work must be corrected for velocity change in the perma-frost layer, as well as in the normal weathered or low velocity layer, which may or may not occur below the frozen zone.

In order to take advantage of the summertime daylight, geophysical crews could profitably be equipped with two or three complete work shifts during June, July, and August.

Economic Considerations

The Norman Wells Field and the Canol pipeline as developed by the U. S. Army were no more capable of paying dividends in cash than a battleship or a squadron of B-29's. However, with the present and future demand for crude oil and with the present favorable price structure, the Mackenzie Basin has passed out of the "What can you do with it after you find it?" classification if the geologists find enough oil. That is, it would take a proven reserve of about 150 million barrels before it would be economical to construct 10 or 12-inch pipe lines across the Mackenzie Mountains to tanker terminals on the Pacific Coast. Three or four more pools the size of the Norman Wells field would do the job.

The current exploration boom in Northern Alberta and Northeastern British Columbia (which areas form the southern boundary of the Mackenzie Basin and the Northwest Territories), if successful, will undoubtedly stimulate exploration farther north. The Alaska Highway provides access to the Northeast British Columbia area, and the Northern Alberta Railways system provides access to the north central Alberta region.

Exploration of any kind in this country before the advent of the airplane was limited largely to boat travel along the Mackenzie and the larger navigable tributaries because of the difficulty of traversing the numerous lake and muskeg basins between the mountain uplifts. Now all but the most rugged parts of the area can be traversed in winter by tractor trains and in the summer by the canoe and the airplane.

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MEXICO Opens the Door

--- But U. S. Operators Wary Of Entering

By HENRY OZANNE
Staff Writer

THERE is no danger that American oil interests reentering Mexico incur the risk of a second expropriation or the cancellation of operating contracts which they can now conclude for the development of Mexico's oil resources. This is the assurance given by Antonio J. Bermudez, general director of Petroleos Mexicanos (Pemex), the Mexico state oil monopoly. I put the question directly to Bermudez in these words:

"There is some fear in the American petroleum industry that oil operations by foreigners in Mexico may not be 'safe'—that is, that Mexico again may expropriate foreign interests or cancel contracts. Is there justification for such fears?"

Bermudez replied:

"The very question is absurd and ridiculous. There is no better risk today—without exception—than Mexico. Our policy is to make friends throughout the industry. On several occasions we have said that the door is open for the use of foreign capital in the petroleum business in Mexico. We are ready to discuss contracts with any properly qualified operators, and anybody so qualified can gain immediate admittance to my office to engage in the conversations. Such a person needs only a card or letter from his bank, and it is not necessary that he be introduced by any third party. In fact, we don't want intermediaries involved and I urge no American oil man (or any other) to pay any fee or make any arrangements with any persons for 'contact' purposes. Any bona fide operator can walk straight into my office and discuss his plan directly with me."

I put the following question to Bermudez: "What are the broad principles on which Mexico is prepared to welcome at this time the entry of American capital and skills for the development of Mexico's petroleum resources?"

Terms of Entry

Bermudez answered:

"The conditions under which Petroleos Mexicanos is prepared to accept the entry of American capital and skills are:

"1. Respect for and compliance with the Mexican laws on the part of every foreign operator in the country.

"2. Recognition that foreign operators are entitled to a fair and safe compensation for their investment.

"3. Development of the Mexican oil industry for the benefit of Mexico in the first place, and the fulfilling at the same time of our obligations of an international character—such as sharing our oil with our world friends who are in need of such commodity."

In elaborating on these principles, Bermudez said to me:

"Our petroleum door is open provided foreign investors come with a 1948 mentality. This means that they must completely forget conditions previous to 1938 (year of the expropriation) and recognize that their capital may be invested only if done so precisely within the limits drawn by our legal system."

I asked the Pemex director: "Do you think Mexico may become a significant source of supply of oil for the U. S., especially in the event of a crisis which would endanger American oil interests elsewhere abroad, such as in the Middle East?"

Bermudez answered:

"The great potentialities of Mexico as a producer of oil are recognized worldwide. Mexico is definitely willing to contribute part of its oil for the defense of the Western Hemisphere in the unfortunate event of a war crisis and consequently Mexico wishes to be fully prepared to fulfill this moral obligation. We would wish to do our share by providing oil for war needs. If we succeed in obtaining a substantial allocation of steel from the U. S., to which we consider we are entitled, then we can carry out our program which would place us in a position not only to meet the growing demands of our domestic economy, but also to build up these reserves needed in the unhappy event of a new war crisis."

Modification of Restrictions

I asked Bermudez if Mexico could ever be expected to modify its present position to the extent of granting concession contracts to foreign operators. He replied "Never," adding that it was the will of the Mexican people, expressed in their basic laws, that the country's

sub-soil rights cannot be alienated through any type of "concession" operation.

"What then," I asked, "is Mexico prepared to offer concretely in contractual form with American operators?"

Bermudez explained:

"The draft of a contract which we are prepared to offer has been drawn and turned over to several parties of known good standing who have shown an interest in entering into agreements with Petroleos Mexicanos. The fundamental characteristics of this draft are:

"1. The contractor undertakes to carry out work and services for Petroleos Mexicanos, mainly consisting in the drilling of wells, both for oil exploration and development.

"2. The exploitation of the oilfields is the right of Petroleos Mexicanos.

"3. All oil produced will be the property of Petroleos Mexicanos.

"4. A risk is established for the contractor; that is, he will not have the right to be repaid for the amounts he may spend in the execution of the work unless oil production is obtained. In compensation for this risk, Petroleos Mexicanos offers to pay the contractor if oil is found.

"5. In the latter case, Petroleos Mexicanos will reimburse the contractor his expenses and will pay him the promised premium."

Bermudez added:

"As the source of income of Pemex to meet its obligations is the sale of petroleum products, it offers to devote the proceeds of the sale of a part of the production that may be obtained to, first, reimburse the contractor for his expenses incurred. This part varies between 50 and 80 percent. After that the proceeds of the sale of a part fluctuating between 10 and 20 percent is devoted to paying the contractor the promised profit premium in oil."

Bermudez also explained another type of contract which Pemex is prepared to offer, and which Bermudez terms a "financing contract." By it, he says, the interested parties will furnish Pemex necessary money as well as materials to carry on drilling operations, and Pemex will repay the loan in convenient terms and also binds itself to sell the oil to the lender at the world's market price.

Bermudez said:

"To this date a contract of this type has been entered into with the Cities Service Company and negotiations are being carried on with several companies of recognized seriousness and solvency for the entering into contracts of the first type. These negotiations are well advanced and their satisfactory conclusion is expected soon."

Mexico Reaches Stalemate in Bid For Aid to Develop Oil Resources

MEXICO has reached a stalemate in its efforts to enlist American capital and skills for the development of its own petroleum resources, and it now appears possible that the whole ambitious negotiations entered into with American oil operators may collapse.

Petroleos Mexicanos (Pemex), the Mexico state oil monopoly, itself admitted that the $30 million deal nearly completed with The Texas Company may be abandoned. And Cities Service Company, which has already signed a reported $10 million arrangement with Pemex, has run into difficulties that raise the possibility that the contract may be canceled or allowed to lapse after its first year of life. It is known that other smaller operators who have had contract deals under discussion with Mexico have temporarily at least retired from the picture.

In the Texaco squabble, Pemex jumped the gun and issued a statement in which it justified its changed position on several points in the contract under negotiation. It said:

"Since the end of 1947, Pemex has been negotiating a sales contract with The Texas Company with a $30 million advance to finance (1) construction of a plant to manufacture lubricants; (2) construction of a refinery; (3) construction of a pipeline across Tehuantepec Isthmus; (4) purchase of a tanker.

"In the meantime Pemex finds itself in a position of being able alone to finance construction of the pipe line and considers it no longer necessary to purchase a tanker.

"Pemex's present plan is to (1) construct the lubricants plant; (2) build the refinery; (3) use the balance of the foreign money originally destined for the pipe line and the tanker for the purchase of drilling equipment and pipe which are necessary to increase the volume of petroleum for export."

Cities Service Difficulties

Difficulties in the Cities Service deal are of a different nature. Pemex, on signing the Cities Service contract, asked the American company to assist in obtaining equipment and supplies for use in Mexico. Cities Service agreed to do this, but its efforts have not been regarded by Pemex as adequate.

Pemex has announced that only 53 exploratory wells are scheduled in the 1948 program because of difficulties in procuring equipment and materials. Pemex has taken recourse to drilling contractors who have access to equipment and facilities needed. Such contractors' drilling crews are already operating in the northern regions of Chichuahua and Tamaulipas as well as in the vicinity of Tampico, but their work has been interrupted frequently due to the lack of steel. At the present time 27 test wells are in process of drilling.

Mexico's 1948 production will be in excess of 60 million barrels, Pemex estimates, as against 57 million for 1947. Newer production techniques already introduced into the Poza Rica field are expected to raise the production of this field to 120,000 barrels a day as soon as the installation of pressure maintenance is completed.

At present Pemex has 33 drilling rigs in operation, a large number of them useful for depths of more than 10,000 feet. Pemex also has nine outfits operating for repair and maintenance of existing wells, and four new outfits have been purchased and are scheduled for early delivery. Besides the equipment operated by Pemex directly, drilling contractors have six rigs in operation, three on the northern border and three in the Tampico area.

The newly completed Reynosa Well No. 1 is reported to have flowed at 1000 barrels a day of 50-gravity crude on an eight-hour test in sand at 7075 to 7078 feet on August 10. Plans are under way for a pipe line from Reynosa to Monterrey.

With or without Texaco financial assistance, Pemex is pushing plans for the Isthmus of Tehuantepec pipe line. This line is projected to supply consuming needs along the Pacific Coast, a long problem in Mexico's distribution efforts. The line will be 155 miles long and at first will be used to transport gasoline, kerosine, and diesel oil processed at the Minatitlan refinery. The products will be loaded on tankers at Salina Cruz and distributed coastwise. In the future the Tehuantepec pipe line will be used to transport crude oil to be refined in a projected unit of the Pacific Refinery. This refinery is to be located at Guayamas and will cost about $10 million. Still another refinery is planned for Monterrey as new fields are opened near there.

Pemex announces it will extend the Salamanca pipe line a distance of 160 miles to Guadalajara where a 10,000-barrel refinery will be constructed at a cost of about $8 million.

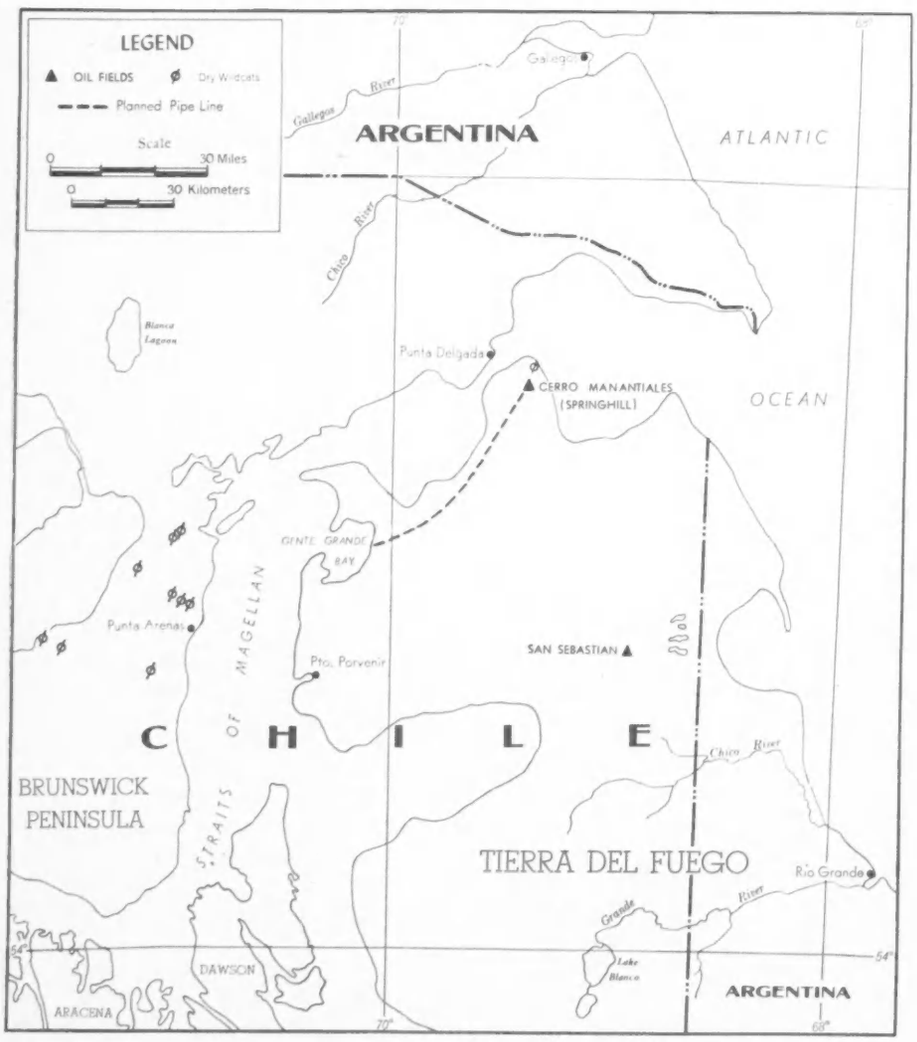
San Sebastian Discovery

Brightens Oil Outlook In Chile

CHILE'S Corporation de Fomento de la Produccion, the government agency charged with the development of its infant industry, is greatly encouraged by developments of recent months which have resulted in discovery of a new oil field.

The new field is located at San Sebastian, some 55 miles southeasterly from the Cerro Manantiales (Spring Hill) field discovered in 1945, and aside from its obvious importance as a possible source of additional crude oil it establishes a definite trend along a line of folding already partially established by geophysical means. San Sebastian 1, the discovery well for the new erea, has not been placed on production, since no outlet yet exists for oil from either Cerro Manantiales or the new area, but sand conditions have been found to be better than in Cerro Manantiales, and production is from a slightly lesser depth. At 7100 feet the new well is some 200 to 300 feet shallower than the wells in the original field, and the section consists of 100 feet of sand, the same sand as that from which Cerro Manantiales produces.

Sand is pre-Eagleford in age, shows good saturation with 40-gravity oil, and responds well to the initial testing. As to producing potentialities, the operators have not found it possible with limited storage facilities to run tests of enough duration on any of the wells to estimate any too closely just what they will do under conditions of sustained producing operations. Meanwhile, the rig which drilled the discovery well at San Sebastian is to remain in the area and continue working to try to outline the producing area. On the basis of preliminary geophysical work it is assumed that the structure from which the production comes is anticlinal in nature and somewhat larger than Cerro Manantiales.



Map of southeastern Chile shows location of new San Sebastian oil field and route of pipe line planned from the Cerro Manantiales field.

Prospects Brighter

The latter field has maintained operations with two drilling rigs, and five wells have been completed since the beginning of the year. As of the middle of August the field has eight oil wells, five gas wells, and only two dry holes. Shortly after discovery, the fact that the five wells drilled immediately thereafter were either dry holes or gas wells made the outlook anything but encouraging, but beginning with Well No. 7, completed in August of 1947 as the second oil producer, results have been much better as more subsurface information has been collected. It now seems that the producing area will be much greater than the 400 acres proved at the end of the year or the 700-acres now proven for oil production. The oil section in present successful wells averages about 65 feet.

One disappointment was registered in drilling a wildcat on the Espora prospect about four miles north of the field itself, which was a dry hole at 7300 feet, but which offered encouragement for future prospecting since the sand conditions were found to be almost identical with these in the oil field. Also of added importance is the conclusion, based on information from drilled wells, that there should be an effective water drive in the Cerro Manantiales field.

The existance of a fairly regular and continuous occurrence over a considerable area of the sand already found productive, plus the discovery of another field along a continuous line of folding

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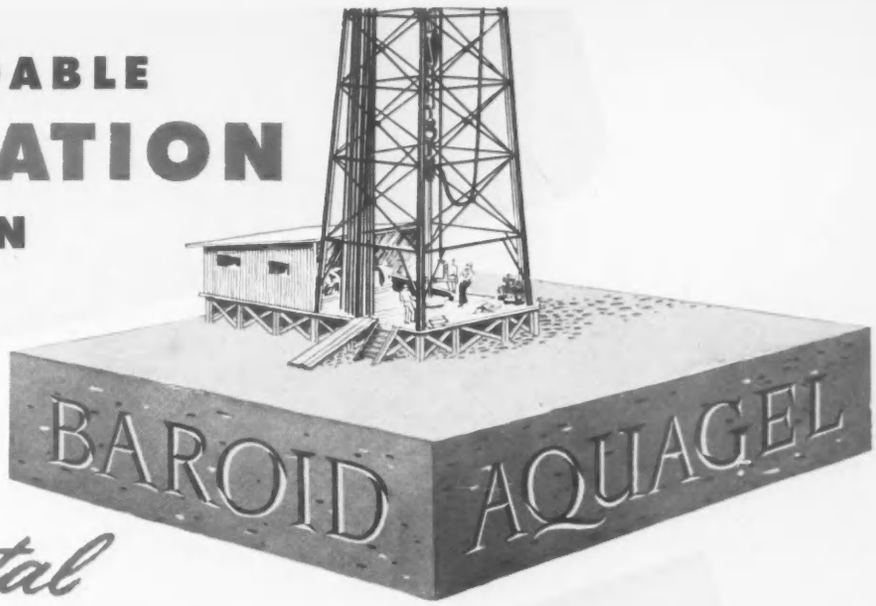

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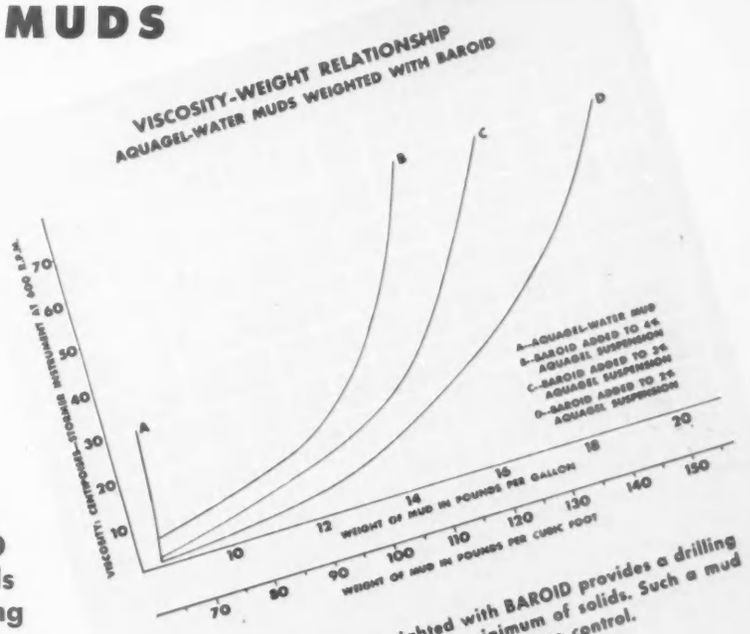
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WEIGHT OF MUD IN POUNDS PER GALLON
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A
B
C
D
A—AQUAGEL-WATER MUD
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from the known field, has intensified interest in the island of Tierra del Fuego on the part of the Corporacion, and it has indicated that prospecting by geophysical means will be accelerated. The agency has acquired a seismograph outfit which will be used primarily in experimental work while training its personnel in operation techniques and interpretation. At the same time it will continue its contract with presently working geophysical contractors. It has already activated a gravity meter crew from which it has obtained some good results, and is now beginning to coordinate its activities with the overall exploratory program. Recently the agency obtained permission to run a geophysical profile from the area of activity on Tierra del Fuego, northward on the mainland, to a point near Gallegos in Argentina, where a wildcat had been drilled by the Argentine Y.P.F. Information from this shooting has been made available to both governments and a valuable link was established between two points where the subsurface had been investigated by drilling.

Test Drilling Planned

Plans are underway by Argentina for test drilling on the island between the Chico and Grande Rivers, at a point where they have done considerable work, and on the line along which the Chilean company has found Cerro Manantiales and San Sebastian fields.

Plans are now underway for the first pipe line outlet from Cerro Manantiales. The route is being prepared and actual construction is to get under way in time for completion of the line around the first of June, 1949. The line will be 45 miles in length, built of 8-inch pipe, and will terminate at a deep-water port on Gente Grande Bay, off the Straits of Magellan. The design of the pipe line is being handled by Williams Brothers, but actual construction work is to be undertaken by the Corporacion de Fomento de la Produccion. Although plans for a refinery are in the offing, the operation now calls for transportation of the oil to a point where it can be loaded on tankers for world markets rather than for strictly internal consumption. The country's need of oil and products will still have to be satisfied by imports. Although the potential thus far estimated for the producing areas will not be enough to satisfy all of the domestic demand, it should be enough to go a long way toward balancing their requirements. Currently the nation is consuming about 16,000 barrels daily of various products, and it is not thought that initial potential production at the time the line is completed will be that much. It is conservatively estimated that wells already completed should furnish about 4000 barrels daily, although on production they may prove to be capable of producing more.

At the present time there are no plans afoot for any work on the mainland of Chile. Practically all the favorable petroliferous areas are located in the southern part of the country with only a few areas elsewhere along its 3000-mile length. The island of Tierra del Fuego contains most of the favorable area and it is likely that it will receive practically all of the attention for some time to come.

Oil Depot Under Construction At Zwolle in the Netherlands

The Standard A. P. C. is engaged at Zwolle (the capital of the province of Overijsel) on the construction of the second largest oil depot in the Netherlands. It consists of five above-ground tanks which are to be completed in August. The Standard A. P. C. supplies the finished petroleum products, mostly from America. Pernis, near Rotterdam, is the central repository from which gasoline, kerosine, and gas-oil are further distributed over the Netherlands. Three of its storage tanks have a content of 1000 barrels each, the fourth has a capacity of 4050 barrels, and the fifth of 5500 barrels, making a total capacity of 12,550 barrels.

British Oil Representative To Be Tried for Misusing Funds

Alexander Walter Evans, British representative of the British and French shareholding group of the Roumanian oil company "Steaua Romana," has been committed for trial on charges of having misused £25,000 received from Distributsia, a company distributing oil products in Roumania.

Evans' arrest by Roumanian police at the Hungarian border on June 8 caused a strong protest to be made to the Roumanian Foreign Office by the British Minister in Bucharest, Adrian Holman.

Demand for Drilling Concessions In Italy Reported To Be Great

At a recent meeting of Italy's Supreme Mining Council, called to discuss the possibility of granting new drilling concessions on Italian territory, the Minister of Industry and Commerce said that the number of applications received had been so great that the Italian Government would have to screen them with the utmost care in order to prevent grants to organizations who would be unable to fulfill their obligations.

Arabian American Oil Company Leases Former Army Airfield

The Arabian American Oil Company has announced the lease of the Suffolk County Army Airfield near Westhampton, Long Island, N. Y., for use as a training center and maintenance base.

The oil company will use 26 barracks and other buildings as a training school for employees preparing to leave for Saudi Arabia. The property was subleased from the National Aircraft Maintenance Corporation, which will service the company's planes. Facilities include three long runways, capable of handling large planes.

The company's training program for employees, which will be in operation by October 1, will include intensive courses in the language and customs of Saudi Arabia and the technical and administrative practices of company operation.

Two Deep Wells To Be Drilled Near Coalisland, North Ireland

An arrangement to drill two deep wells and deepen an existing shallow hole in the area east of Coalisland, Northern Ireland, has been entered into between the Ministry of Commerce for Northern Ireland and Richardson, Timmons and Company of Bletchley. This work forms part of an exploratory program for mineral development which the Northern Ireland Government is undertaking. The drilling is designed to evaluate the geology of the region between Coalisland and Lough Neagh, where there is probably an extensive hidden coal field.

French Oil Companies Merge; Two Others Increase Capital

The Standard Française des Pétroles, French subsidiary of the Standard Oil Company of New Jersey, is merging with the French Compagnie Generale des Pétroles pour l'Eclairage et l'Industrie.

The French subsidiary of the Royal Dutch-Shell group, S. A. des Pétroles Jupiter, has increased its capital by 50 percent. The Raffinerie Française de Pétroles de l'Atlantique, the company formed recently by the amalgamation of Les Consommateurs de Pétrole with S. A. Pechelbronn-Ouest, is shortly to increase its capital to 650 million francs. Proceeds of the issue will be used for reconstructing the refinery at Donges, near Nantes.

The Pechelbronn Company's production was 29,750 barrels in June, and 182,966 barrels in the first six months of 1948.

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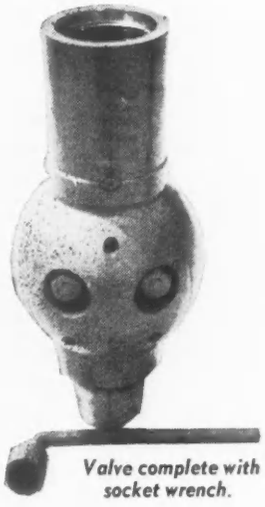
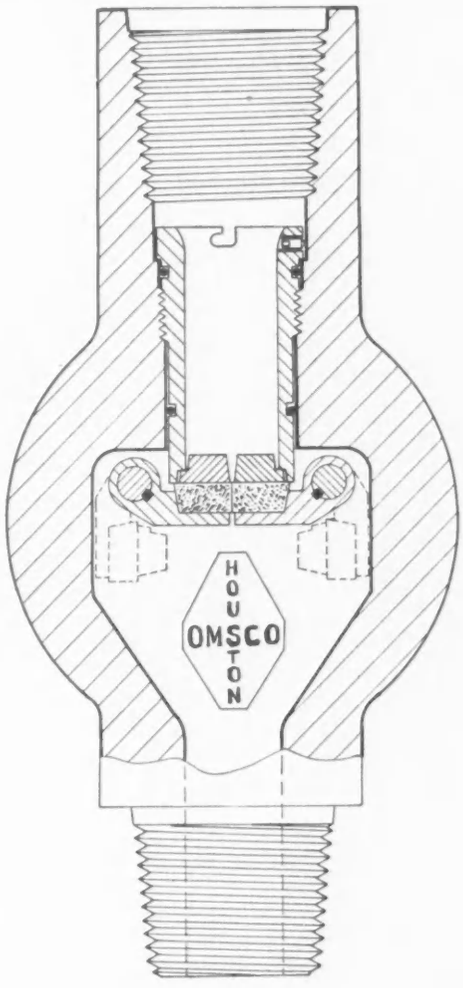


Valve complete with socket wrench.



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OMSCO 10,000 lb. test Kelly Valve has no friction areas to stick or "freeze"; requires no lubrication. Ram shafts ride in chevron packing. May be completely redressed in the field; rams and valve seat are easily replaced right on the derrick floor. This valve has a rubber to metal seal, eliminating the hazard of cutting out or "freezing" from sand or mud particles. Includes OMSCO Pressure Seal feature, as more pressure is applied under the rams when the valve is closed, the rams seat even tighter.

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Western Canada Production

Reaches New High

PRODUCTION from the Bahia fields of Brazil increased by 2240 barrels in the month of May and was largely from the Candeias field's six wells, the only other field producing during that time being Aratú. In April, some production was obtained from the Lobato-Joanes and the Dom João fields as well, but only four wells in Candeias were active.

Western Canada production reached a new high in June of 983,111 barrels, 32,770 barrels daily, to boost the total for the first six months of 1948 to 4,843,962 barrels, an increase of 1,444,054 barrels over the 3,399,908 barrels produced the first half of 1947. A continued increase is expected in the final half of the year, with total annual production expected to reach or exceed 12 million barrels. With the exception of 82,603 barrels in June and 374,065 barrels in the first half year period, which were produced in the Saskatchewan area, all Western Canada production is from Alberta Province. Last complete Government figures for Canada were issued in April, when total Canadian production was given as 795,724 barrels, 15,155 of which were Eastern and the remainder Western production.

Colombia's fields are maintaining a fairly steady daily average of 60,957 barrels per day, the main production coming from the De Mares concession. The Casabe field of the Yondo concession, which averaged about 13,572 barrels per day in 1947, is currently running around 15,000. El Dificil field of the Shell Group will have a pipe line outlet in September and is expected to produce about 3000 barrels daily at the start. There are 13 producers in the field, of varying capacities.

French production of crude in April was 30,185 barrels, compared with 30,495 barrels in March and 29,563 barrels in February.

German production in May rose slightly as compared with the preceding month, the increase being due to further development of the Emsland fields, a new field in that area being put into production and existing wells showing increasing output. Northwest Germany accounted for 357,077 barrels and Baden, south Germany, for the remaining 3,626 barrels. Total German crude production for the first half of the year amounted to 8,078,370 barrels or an increase of 8 percent over the corresponding figure for 1947.

Kuwait, from which the first oil was shipped commercially in June, 1946, has increased its production steadily in recent months. Completion of loading and transportation facilities should bring further increases soon. At the beginning of the year a daily average of 62,000 barrels was being maintained from the 13 wells then producing in the field. The daily average during June was in excess of 100,000 barrels. During the first half of 1948 Kuwait produced more than half as much as was produced during 1946 and 1947 combined.

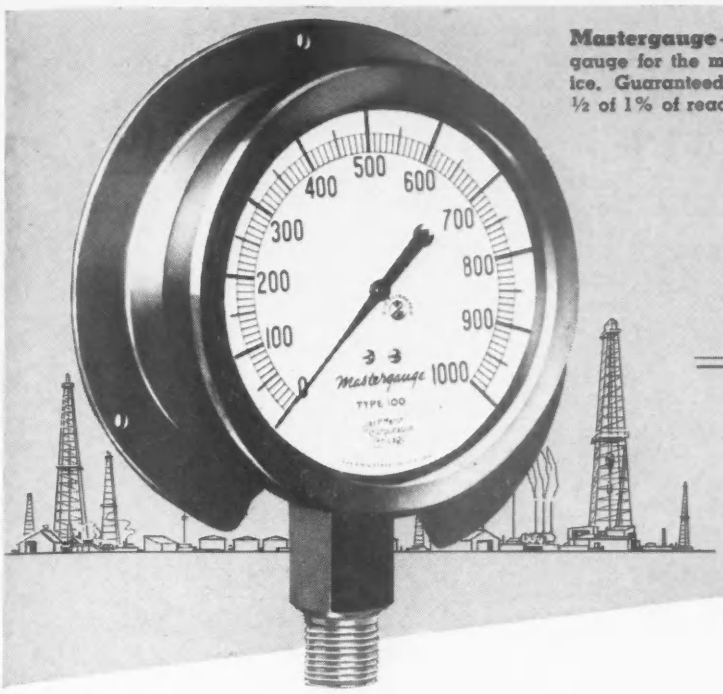
Crude Oil Production

COUNTRY	COMPANY	PRODUCTION Month	PRODUCTION Barrels
Brazil	Conselho Nacional do Petroleo	April	8,263
		May	10,503
Canada:			
Eastern		April[1]	15,155
Western		June[1]	983,111
Colombia		July	1,880,667
Ecuador	Anglo-Ecuadorian Oilfields	May	140,153
		June[2]	92,040
	British Controlled Oilfields	May	59,114
		June	56,388
Egypt	Anglo-Egyptian Oilfields	May[3]	833,024
		June[4]	698,549
France		April	30,185
Germany		April	350,987
		May	360,903
Iran	Anglo-Iranian Oil Co.	June	14,287,000
Iraq	Iraq Petroleum Co.	May	1,677,700
		June	2,194,100
Kuwait	Kuwait Oil Co.	May	2,947,600
		June	3,173,639
Mexico	Petroleos Mexicanas (Pemex)	April	4,426,376
	Mexican Gulf	April	34,658
	New England	April	24,470
	Miscellaneous	April	159,575
Peru	Lobitos Oilfields	May	183,085
		June	182,280
Roumania		April	2,331,000
Trinidad	Apex (Trinidad) Oilfields	May	270,041
		June	258,527
	Kern Oil Co.	May	41,153
		June	40,799
	Trinidad Central Oilfields	May	47,133
		June	44,644
	Trinidad Leaseholds	May	504,624
		June	475,520
	Trinidad Petroleum Development Co.	May	223,735
		June	217,491
	United British Oilfields	May[3]	409,774
		June[4]	402,497
Venezuela	British Controlled Oilfields	May	32,229
		June	29,039
	Colon Development Co.	June	338,267
	Creole Petroleum Corp.	May	19,968,123
	Venezuelan Oil Concessions	May	8,488,801
		June[4]	8,593,357

[1] In barrels of 35 gallons.
[2] Reduced figure due to oilfield workers strike from June 21 to July 9.
[3] Four weeks ended May 31.
[4] Four weeks ended June 28.

Consolidated Refineries, Ltd., To Move Head Office to Cyprus

It is reported that Consolidated Refineries Ltd., intend to move their head office from Haifa to Cyprus. The executive personnel are expected in Cyprus shortly, while plans are under consideration for the erection of a refining plant to handle crude oil in the Larnaca district of the island.



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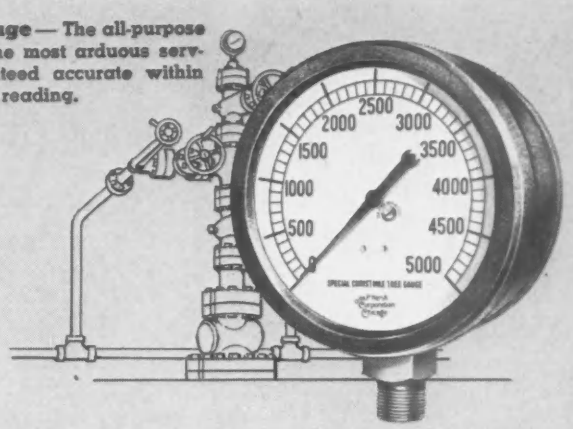

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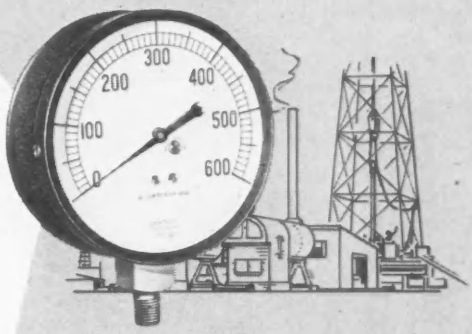

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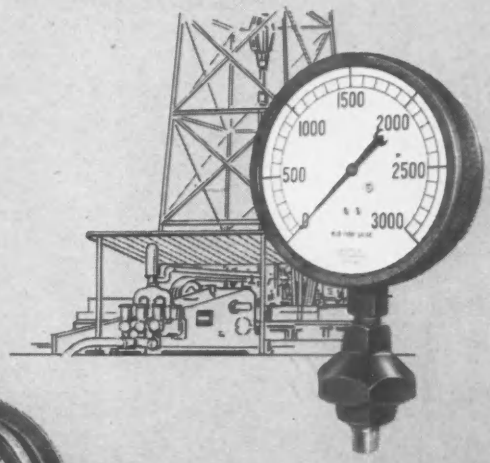

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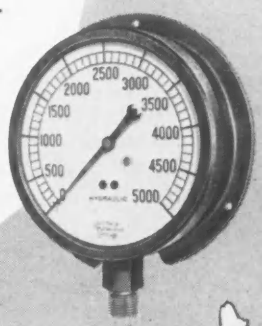

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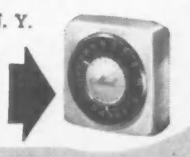


The Marsh branch plant at Houston offers shipment from stock and facilities for repairing all makes of gauges.

MARSH GAUGES

Leduc Crude Flows to New Refinery

THE newest addition to Canada's petroleum industry officially went "on stream" July 17 when Imperial Oil, Ltd's Edmonton refinery was formally opened. The ceremonies, attended by government, municipal and company officials, took place just 17 months after Imperial brought in the discovery well that established the Leduc field as the largest known source of crude oil in the Dominion.

Atlantic No. 3 in Leduc Field Still Running Wild in August

Atlantic No. 3 was still running wild at Leduc in August with a total of 865,732 barrels of oil accounted for by July 31. During first week of August the well was putting out 8000 to 9000 barrels daily through craters around the wellhead, slowly declining from the June peak of more than 14,000 barrels daily. In July, 312,528 barrels were accounted for, 252,912 barrels being marketed by the Conservation Board (which took over the well May 14), and 59,616 barrels being returned to the formation through the neighboring Atlantic Nos. 1 and 2 wells.

Of total oil accounted for, the Board had marketed 643,023 barrels (for $1,913,000) by July 31; Atlantic Oil Company had marketed 39,231 barrels (for $113,769), and 183,478 barrels had been restored to the formation. Some light ends are lost in passage of oil through channels and while waiting in open pits for pumping into pipe line, and gravity of the crude is about 32.8 compared with Leduc's normal 39 to 40 gravity. As a result, average price paid is now $2.95 per barrel, compared with normal wellhead price of $3.45.

The Board is using fund to pay costs of control efforts and will have to meet claims for royalty and damages before deciding on final distribution of any remaining proceeds. Two relief wells, to be used for water flooding, had not been completed on August 10. The west relief is at 5225 feet, reaming out before running pipe. The south relief, which reached casing level (5222 feet) in mid-July, was unable to run pipe past 3700 feet where deviation of hole towards wild well started. Redrilling from that depth, new hole was at 4444 feet August 7 and held up by a twist-off.

The refinery will be in full production by the end of the year and will process 6000 barrels of Leduc crude daily. An increase in its capacity to 11,000 barrels a day at a further cost of $2,500,000 is under consideration. It will serve the northern half of Alberta and will supply a larger area as capacity is increased.

It is estimated that the products from the refinery will save the country in the neighborhood of $6 million yearly in scarce U. S. dollars by replacing imports.

Refinery Site

Located on the south bank of the Saskatchewan River near Edmonton's outskirts, the refinery site covers 360 acres of land. It contains a crude distillation plant which is producing gasoline, kerosine, diesel and heavy fuel oils. A "cracking" unit is under construction which will break down heavier oils to produce a full range of motor gasolines as well as tractor distillates, household heating oils, and other products. The possibility of providing facilities at a later date for the manufacture of lubricating oil is also being considered. When the refinery is complete there will be operating tankage for 680,000 barrels of crude and finished products.

Its latest move has earned the plant the title of the "most travelled refinery in the world." Originally the main units were located in Corpus Christi, Texas. When war in the Pacific broke out, the Texas plant, together with other units and parts from hundreds of centers in Canada and the U. S., was dispatched to Whitehorse, Yukon Territory. Here it took shape as the most northerly refinery on the continent.

The discovery and development of Leduc, which now has estimated reserves of 200 million barrels, indicated the feasibility of a local refinery. The idle Whitehorse refinery was purchased from U. S. war surplus goods for $1 million. Last winter it was dismantled and its sections transported over the Alaska Highway to Dawson Creek and thence by rail for re-assembly at the Edmonton site, 1350 miles away. Because of the difficulties of this engineering feat the final cost of the refinery has risen to an estimated $8,700,000, but Imperial has been able to save 18 valuable months in getting production under way and the refinery will provide products which might not otherwise have been available with the present tight supply situation.

When the plant originally was assembled in Whitehorse during wartime, it was built to withstand extreme winter temperatures. This involved enclosing practically all equipment within walls. The same construction is being followed in Edmonton making this refinery unique among such plants in Canada.

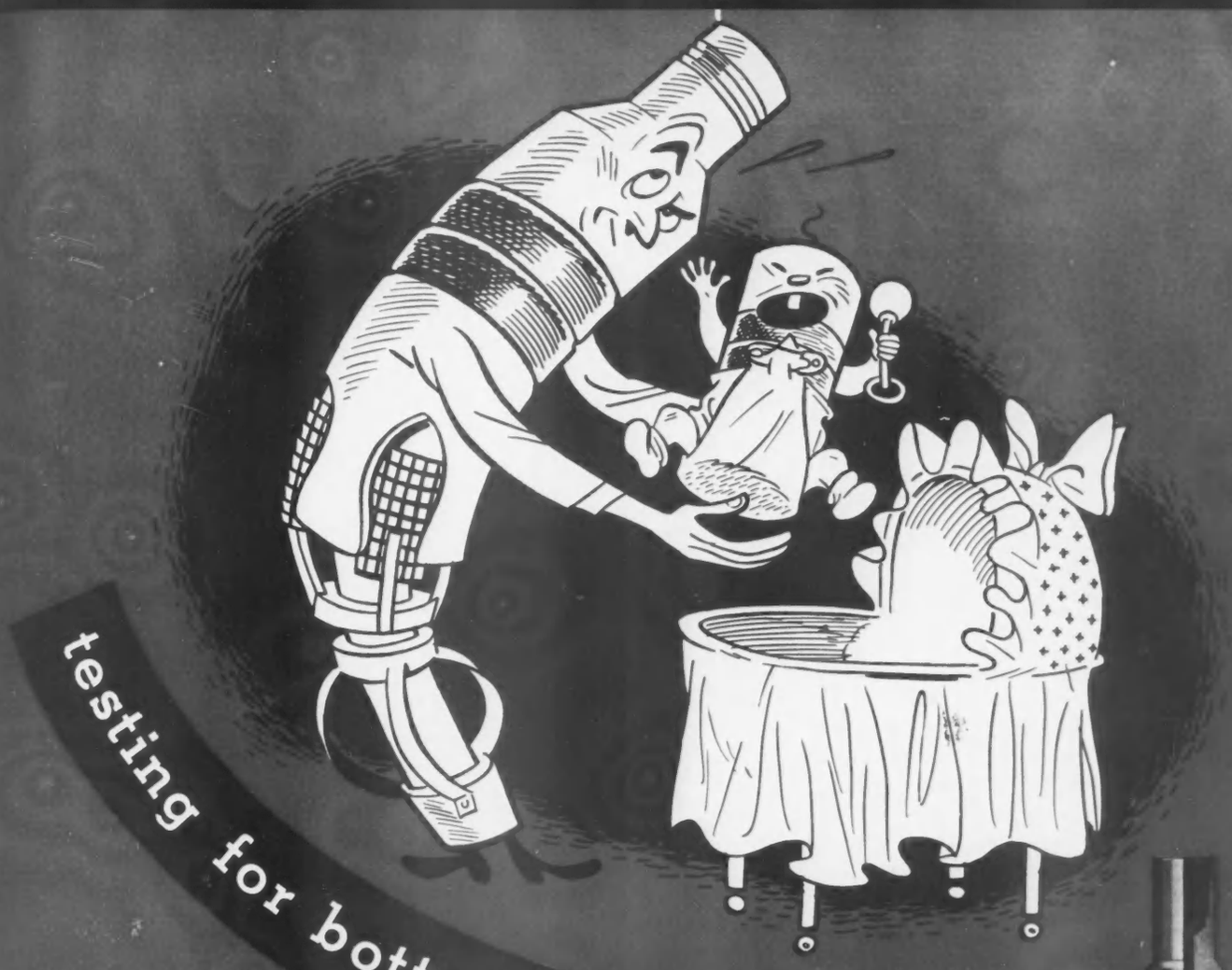
On June 7, the first Leduc crude arrived for storage at the refinery in preparation for early test runs. Trucks hauled the crude from the field at the rate of 2000 barrels daily and now this has been stepped up to 4000 barrels. This hauling involved 100 truck trips a day over the 28-mile route. Today Imperial is laying an 18-mile pipe line extension to join up with the company's existing pipe line from Leduc to the railway loading point at Nisku, eight miles east of the field.

Report on Iniskin Peninsula Open for Public Inspection

A preliminary report on the geology and petroleum possibilities of the Iniskin Peninsula, Alaska, has been placed on open file for public inspection in advance of publication.

The Iniskin Peninsula is on the west side of Cook Inlet, about 150 miles southwest of Anchorage. Seepages of high-gravity oil have long been known on the peninsula, and several wells have been drilled. Shows of oil and gas were reported in some of the wells, but petroleum has not been produced in commercial quantity.

The report, by C. E. Kirschner, is based mainly on investigations on the Iniskin Peninsula by geologists L. B. Kellum and Helmuth Wedow Jr. in 1944, and C. E. Kirschner and D. L. Minard in 1946, but also includes results of earlier investigations by the Geological Survey of the Department of the Interior. The report, which consists of a typewritten text, a geologic map, structure sections, and graphic columnar sections, is not available for distribution, but may be consulted in offices of the Geological Survey at rooms 4217 and 1033 (Library), Federal Works Agency Building, Washington, D. C.; room 533, Post Office and Court House, Los Angeles, Calif.; Fairbanks, Alaska; and Juneau, Alaska.



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FLOSEAL PACKING RING ASSEMBLY gives positive packoff under differential pressures up to 7,000 P. S. I. and temperatures as high as 300° F. The rings recover their shape when released—won't vulcanize to casing—resist heat and pressure.

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Israel May Turn to Russia For Supply of Crude

RUSSIA may obtain its first grasp on the strategic oil of the Middle East through an arrangement between the new state of Israel and the Soviet Union by which Russia would furnish crude oil for the operation of the Consolidated Refineries, Ltd., plant at Haifa, Palestine. Possibility of such a deal has been admitted by Israeli officials themselves, who contend that it would be simply a reversion to an old practice since Russia was a chief source of supply for the Eastern Mediterranean area before the Iraq Petroleum Company opened its pipe line in 1934.

The threat by the state of Israel to turn to Russia as an oil source emphasizes the growing difficulties in political and economic dispute now enveloping the whole Middle East oil question. The British closed the Haifa refinery on April 26 after clashes had occurred between Arab and Jewish workmen. IPC transferred its technical staff to Beirut and Tripoli, and the Arab personnel,, comprising half of the ground force, was forbidden by Israeli action to return to work. The refinery was further handicapped when IPC shut down the Kirkuk-to-Haifa 12-inch pipe line which previously had been delivering 47,000 barrels of crude daily to the Haifa plant.

Reopening of Refinery

On July 29 Israel reopened the refinery by pumping back into the plant the last of 20,000 tons of crude and tank bottoms that were in storage tanks. Israeli officials said this would be refined and then given to Shell and Socony-Vacuum company representatives "from which it will be purchased by consumers." Israel argues that the Haifa refinery has not been confiscated and the oil has not been expropriated. The British contend that in effect expropriation has been carried out. The dispute is in the hands of the United Nations and on its settlement depends not only the fate of the refinery but the operation of the IPC line. Dr. Nadim Alpachachi, Iraq's general director of economy, declares that the pipe line will not be reopened if the Haifa plant remains operated by the Jewish state. He demands international control of the refinery.

Actually, the refinery would not be able to maintain operations more than a couple of weeks unless crude were supplied. It is in this connection that Israel announces it may negotiate with Russia to supply that crude. Russia has championed the new Jewish state and is said to be eager to work out an oil deal with Israel. Israel officials at Tel Aviv declared:

"The Government feels satisfied that the reopening of the refinery is amply justified by the emergency situation, as regards the supply of oil in Israel, and is fully in keeping with the urgent world need for an increased supply of refined oil to which the closing of the Haifa refinery was so obviously detrimental."

The British have refused to cooperate in the present operation of the refinery and Cyril Marriott, British consul general at Haifa, protested to Israeli authorities against its reopening. This protest, he said, was lodged on behalf of the British Government, IPC, and Consolidated Refineries, Ltd.

Meanwhile IPC is leaving incompleted its 16-inch pipe line from Kirkuk to Haifa. The line has been laid for more than 500 miles across Iraq and Transjordan and only about 78 miles remains to be finished. IPC plans meanwhile to go ahead with work on the north leg of the line, from Kirkuk to Tripoli. This new line, paralleling the existing 12-inch system, could be completed without political interference since it crosses Iraq, Syria and Lebanon through all of which countries IPC has settled transit rights.

Danish-American Prospecting Company Continues Exploration

Albert Gregerson of Wisconsin, vice president of the Danish-American Prospecting Company, a wholly-owned subsidiary of the Gulf Oil Company, has revealed that his company has spent the equivalent of £850,000 since the end of the war in making preliminary investigations in Denmark, and that it may be another five years before the whole of Denmark has been completely explored.

The venture began just before the war, when the Danish-American prospecting Company took over a 50-year concession granted by the Danish Government to seek oil in Denmark. Operations, halted by the Nazi invasion in 1940, were resumed in the summer of 1946. Since then, some 56,000 feet have been drilled in various parts of the country and 18,000 preliminary survey stations set up at a spacing of 1½ kilometers. (1.6 kilometers=1 mile).

So far, no oil has been found, but of the total of about 40 holes drilled, nine have encountered salt. Investigations are now being made to see whether exploitation of Denmark's vast salt deposits would be profitable.

The company is now preparing to drill the deepest hole yet attempted in Denmark—between 10,000 and 12,000 feet, a little to the north of the Jutland town of Randers.

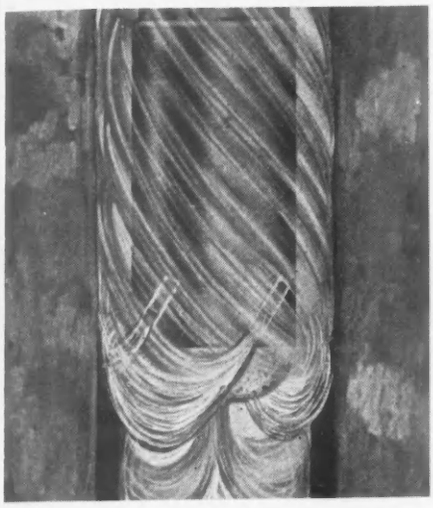
Crude Production in Germany Shows Slight Decline in April

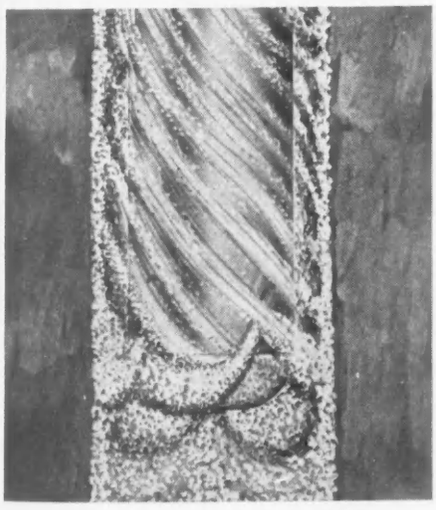
The monthly report of the Control Commission for Germany (British Element) reports April output of crude oil at 338,070 barrels, slightly less than the 364,050 barrels for March. Production in some of the older oil fields such as Heide and Nienhagen is stated to have been falling, but the three Emsland fields on the Dutch border are showing steadily increasing production. Nienhagen output might be improved by an extensive cleaning-out program, but lack of equipment is delaying this work.

The output of finished products from refineries during April is estimated at 404,820 barrels as compared with the actual figure for March of 357,340 barrels. There is still a shortage of labor and building materials which is retarding the agreed reactivation of various plants. The British American Bizone contracted to purchase 718,830 barrels of crude from Venezuelan sources as part of the allotted crude imports of 1,519,812 barrels in the second quarter of 1948. The Venezuelan crude is for refining use of Ebano-Asphalt-Werke at Hamburg-Harburg, Shell's refinery at Monheim on the Rhine, and the Deutsche Gasolin A. G. plant at Dollbergen, near Hanover.

The decision to reopen the large German coal-oil plants at Wesseling and Gelsenkirchen-Buer for the topping of imported crudes has been followed by the consent of the occupation authorities to the resumption of hydrogenation operations in the Bizone. The Potsdam regulations, forbidding the operation of hydrogenation plants throughout Germany, were later modified, and the Russians are believed to have started coal hydrogenation on a considerable scale. The Western allies still object to coal-oil synthesis, largely on economic grounds and also because of the shortage of coal, but some of the existing hydrogenation facilities are now to be used for the treatment of oil residues obtained by distillation.

IS NOTHING "JUST AS GOOD" AS successful first-time cement job





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"Whirler" CEMENTING EQUIPMENT

Body Recommends Manufacture Of Gasoline from Coal in India

Recommending the early establishment of an industry for the manufacture of synthetic gasoline from Indian coal, the Governing Body of the Indian Council of Scientific and Industrial Research has set up a committee to work out the details of the plan for the consideration of the Government. The committee, which consists of G. D. Birla, Sir S. S. Bhatangar, Sir J. C. Ghose, and D. N. Wadia, is working in consultation with foreign experts. Second and third-grade qualities of coal will be utilized for the proposed production of synthetic gasoline. This will be to India's advantage since her resources of first grade coals are limited.

The council decided that intensified geological and geophysical exploration of possible petroleum areas should be carried out by the Government. It was also recommended that the possibility of buying crude petroleum from Iranian and Burma oilfields and refining it at Indian ports should be investigated.

Bizonal Germany to Purchase Crude Oil from Middle East

Bizonal Germany has contracted for the purchase of 630,000 barrels of crude oil from the Middle East. The crude oil, which will be refined in Germany for use in the Bizonal area, will be from Arabia and Kuwait. The oil will be delivered during the remainder of 1948 and will be primarily converted into gasoline and Diesel oil.

This latest purchase brings the total of crude oil bought for the reconstruction of the German refining industry under the two-year plan to nearly 1,400,000 barrels. The plan envisages the rebuilding of the industry to a capacity of 18 million barrels a year. This refining program is expected to save approximately $25 million annually, until now spent on importing finished petroleum products for the Bizonal economy.

A total of 1,554,000 barrels of crude oil will be imported into the Bizone in the second half of this year, compared with 630,000 barrels in the first half.

Gulf Oil Corporation Granted Concessions in East Africa

Concessions totalling 45,000 square miles of land in Portuguese East Africa have been granted to Gulf Oil Corporation interests.

The Aero Service Corporation of Philadelphia has been commissioned to map and survey the concession by the Mozambique - Gulf Oil Company, a wholly owned subsidiary of Gulf Oil. A Douglas transport plane, specially fitted with a magnetometer, has already reached Lourenco Marques.

Three new oil companies have been formed in North Africa under the sponsorship of Anglo-Iranian Oil Company and the Société Général des Huiles de Pétrole. The new companies are L'Anglo-Marocaine des Pétroles, Casablanca; La Société Algerienne des Huiles de Pétrole, Algiers; and La Société Tunisienne.

Netherlands East Indies Refines 12,012,255 Barrels in 1947

Total refinery output in the Netherlands East Indies, according to preliminary figures, was 12,012,255 barrels last year, compared with 49,076,640 barrels in 1940. The 1947 yield included 2,794,815 barrels of gasoline, 1,611,495 barrels of kerosine, 7,520,310 barrels of fuel and diesel oil, and 85,635 barrels of asphalt.

Exports, which were very modest until recently, have recovered during the last few months, amounting to 5,978,880 barrels in the first quarter of 1948. Shipments in that period were slightly below half the level of 1940 when 49,419,180 barrels of petroleum and petroleum products were exported during a whole year.

In the last few months recovery progress has been particularly marked. Monthly output in January, 1948, amounted to 2,140,875 barrels, and, according to the latest available information, it has now reached a level equivalent to an annual rate of 35,032,500 barrels or over half the prewar scale of production.

Monnet Plan Aiding Recovery Of French Refining Industry

In spite of shortages of dollars and raw materials, the French refining industry is making a very creditable recovery in line with the well-conceived Monnet plan. ERP aid is likely to accelerate this progress and facilitate the purchase of sorely-needed equipment in the U. S. Steel is the major raw material in short supply in France, as elsewhere. Allotments to the refinery industry in the first six months of 1948 were only 25,850 tons against requirements of 50,600 tons for this period.

The program for reconstruction and development of French refineries shows that by 1948-1949 total capacity is expected to surpass that of 1939. In 1939 throughput was 180,000 barrels per day; by 1949 it is supposed to be 208,500 barrels per day. The planned refining capacity for 1951-52 is 361,600 barrels per day. The low ebb of French refining capacity was at the end of 1944, when capacity was approximately 39,000 barrels per day.

Equipment Received in Papua For Drilling New Test Sites

The Australasian Petroleum Company has received most of the machinery and equipment required for drilling at the new test sites at Oroi, Upoia and Hohoro in Papua. A British geophysical party will arrive in Papua in September to carry out a refraction seismic survey of portions of the company's concessions, and arrangements are now completed for despatching a specialist seismic geophysical party, indicating that further data are to be collected on the older rocks underlying the petroliferous Tertiaries.

Salvaging of casing from the Kariava bore has been completed and the rig transferred to Hohoro. J. M. Pattinson, general manager, fields and geological division, Production department, Anglo-Iranian Oil Company, Ltd.; R. S. Mackilligan, in charge of technical operations, D'Arcy Exploration Company, Ltd.; and L. A. Pym, general manager, Australian Petroleum Company, Pty. Ltd., recently visited the concessions in Papua and New Guinea to investigate the possibilities of accelerating the exploration program.

Swedish Fuel Commission Has 90 Million Kroner to Buy Fuel

The Swedish Fuel Commission will have at its disposal in the second half of this year, for purchases abroad of both solid and liquid fuel, at the most the equivalent of 90 million Swedish kroner in dollars.

The equivalent of about 15 million kroner is earmarked for the purchase of American coking coal for gas and iron works, according to a Government announcement, leaving 75 million kroners' worth of foreign exchange for the purchase of petroleum products abroad. As the supplies of petroleum products will consequently be inadequate, gas and iron works will have to use larger quantities of Polish coal. Blocks of flats will not receive quotas of fuel oil until house owners and small industries have received their shares, while large industries will have to expect smaller allocations of fuel oil.

Two British oil experts have arrived in Stockholm to discuss a possible increase in sterling oil shipments to Sweden.

Commercial Oil Deposits Found In River Valleys in East Hungary

It is reported from Budapest that commercial oil deposits have been found in the valleys of the Tisza and Koerdes Rivers in East Hungary. Exploration which was commenced before the war has now been resumed.

NEW AND IMPROVED Equipment SUPPLEMENTING COMPOSITE CATALOG

New and improved equipment of manufacturers who describe their products or services in the current Composite Catalog

129—Diamond Core Bit

This item supplements Oil Base, Inc.'s data as shown on page 3021 of Composite Catalog.

The newly developed Koebelite diamond core bits for coring in hard formations are available in all sizes and in two general styles: the brazed insert type and the mechanical-set insert.

Selected and tested diamonds are set in separate inserts in a powdered metal matrix in a field-proved pattern and firmly brazed into position. The inserts in the mechanical-set bits may be replaced on the job in a matter of minutes. Any damaged portion of the bit can be removed and replaced before excess diamond loss occurs. The diamonds from the worn inserts can then be reset with no appreciable loss. The threaded body can be used over and over, only replacing the inserts as wear occurs, eliminating expensive setting charges.

For additional information, write Oil Base, Inc., P. O. Box 3735, Terminal Annex, Los Angeles, *referring to* WORLD OIL *item 129.*

130—Wire Line Anchor

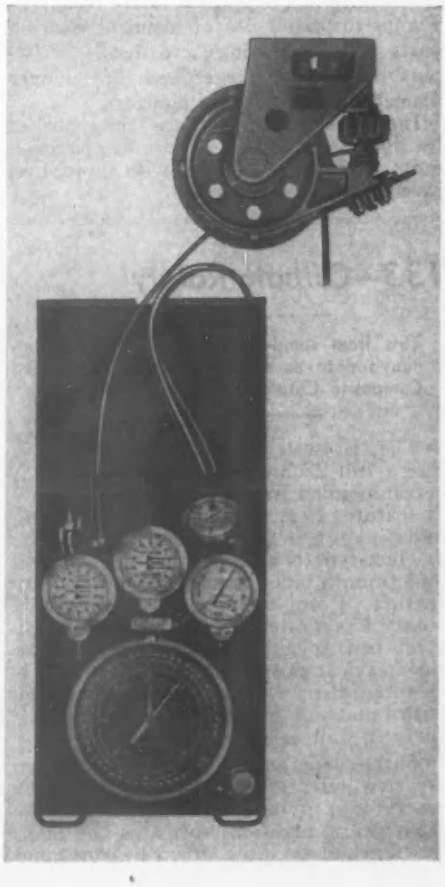
This item supplements Martin-Decker Corporation's data as shown on pages 2505-2536 of Composite Catalog.

The Ideal Type D wire line anchor and the Martin-Decker Type D weight indicator combine the elements of the wheel (for anchoring the wire line) and the lever for measuring the load on the wire line. A gauge at the driller's position registers the force on the lever which is transmitted to the gauge through the hydraulic pressure unit. The load on the hook is shown directly in pounds by the gauge which gives the driller a net-weight-on-bit indicator reading directly in thousands of pounds, a conventional weight indicator for total weight on the drill string showing tight holes, stuck pipe, load on derrick, etc., and a Vernier weight indicator providing the engineer a permanent record of each 24 hours of operation.

The gauge is placed in front of the driller where the slightest change in hook load or bit weight is instantly revealed. It is hydraulically operated and positively unaffected by atmospheric changes. Dead line whip can neither affect weight indicator reading nor damage the instrument. It requires no adjustment for number of lines strung or cable diameter.

Automatic stops on the anchor drum flanges insure a positive anchor for the wire line if the pressure transformer is removed for servicing or if the anchor is used for wire line tie-down only.

For additional information, write Martin-Decker Corporation, 3433-45 Cherry Avenue, Long Beach 7, *referring to* WORLD OIL *item 130.*



131—Push Button

This item supplements The National Supply Company's data as shown on pages 2793-2892 of Composite Catalog.

Another advance toward simplicity of operating dual-fuel diesel engines has resulted from the development of automatic electric controlled accessories operated by two push buttons. With the new type of control these engines give no indication of fuel changes while operating under full or partial loads except by indicator lights above the two change buttons or, if desired, an alarm signal. All mechanical operations that are required in converting the engine from one fuel to the other, except pushing one of the two buttons, are made automatically.

The push button control panel, which is mounted on the governor housing, is used only when the engine is running. One button is marked "OIL" and has an amber indicator light. The other button is marked "GAS" and has a white indicator light. These push button controls are connected with an automatic alarm and safety system, and through electric relays operate a solenoid valve in the gas line.

If there is not enough gas for the engine load, the governor automatically increases oil fuel injection. When this occurs the amber light glows again. If the engine load then decreases, or if the gas supply increases beyond load requirements, oil fuel injection is reduced automatically to pilot ignition volume and the amber light goes out.

For additional information, write The National Supply Company, Box 889, Toledo 1, Ohio, *referring to* WORLD OIL, *item 131.*

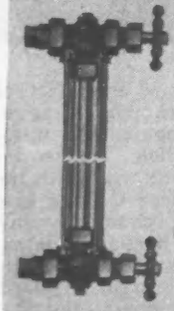
PENBERTHY
Liquid Level GAGES

REFLEX

Reflex type complete with gage valves. Liquid shows black—empty space shows white. Liquid level is always unmistakable.

TRANSPARENT

Transparent type complete with gage valves. Used where through vision is desired under high pressures and/or temperatures.

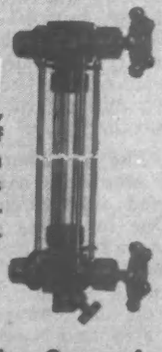


DROP FORGED STEEL

Tubular glass type, Chrome-Moly temperature resisting steel body, stainless steel trim, regrinding removable seats.

ALL IRON

Tubular glass type, extra heavy body of special high strength alloy iron, shanks alloy steel, trim stainless steel, valves self-cleaning.



There is a Penberthy Gage of superior quality for every liquid level gage requirement. Gages are fabricated to customer's specifications from special alloys to meet unusual corrosive and temperature conditions. All Penberthy Gages conform with API-ASME requirements.

3277-B

PENBERTHY PRODUCTS

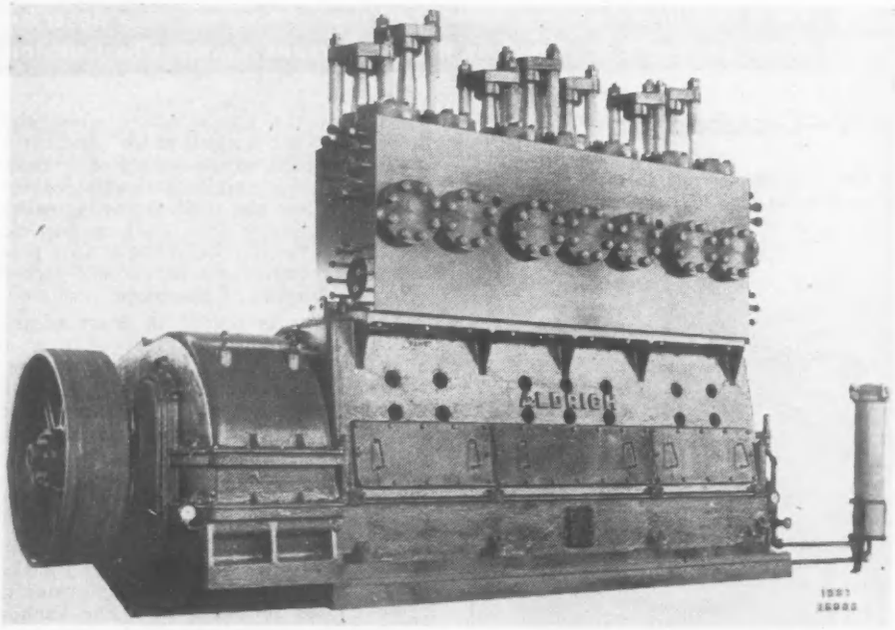
PENBERTHY INJECTOR CO.
Detroit 2, Mich.
Canadian Plant — Windsor, Ontario

NEW EQUIPMENT

SUPPLEMENTING COMPOSITE CATALOG

132—High Pressure Pump

This item supplements Aldrich Pump Company's data as shown on pages 154-157 of Composite Catalog.



Aldrich Pump Company has standardized the design of six-inch stroke Triplex, Quintuplex, Septuplex and Nonuplex and seven-inch, 7½-inch and eight-inch stroke Quintuplex, Septuplex and Nonuplex Pumps to permit use of identical wearing parts such as bearings, crossheads, wrist-pins and valves regardless of plunger diameter and number of plungers.

Increases in capacity are accomplished by increasing the number of pumping units. Pumps are supplied with three, five, seven, and nine plungers.

In the six-inch stroke line, the Triplex has a 300 hp rating, the Quintuplex has 500 hp, the Septuplex has 700 hp, and the Nonuplex carries the hp rating to 900.

The seven-inch, 7½-inch, and eight-inch stroke pumps carry the ratings from 1300 hp to 2400 hp.

Ring joint construction to all flanges can be incorporated, and, if interchangeability of plunger sizes is desired, stuffing box linings can be provided.

For additional information, write Aldrich Pump Company, Allentown, Pa., *referring to* WORLD OIL *item* 132.

133—Oilbath Rotary

This item supplements The Brewster Company's data as shown on pages 717-748 of Composite Catalog.

The Brewster RS-22 oilbath rotary has a full 22 inch table opening and is recommended for drilling to 12,000 feet. It features heat treated spiral bevel ring and pinion gears and oilbath lubrication. Its box-type construction with flush top and smooth sides is an important safety feature. Completely slush proof, this rotary has a one-piece cast electric alloy steel bed specifically designed to take the heaviest possible loads. The skid is an integral part of the base, making the entire machine more compact, shock absorbent, and easy to move.

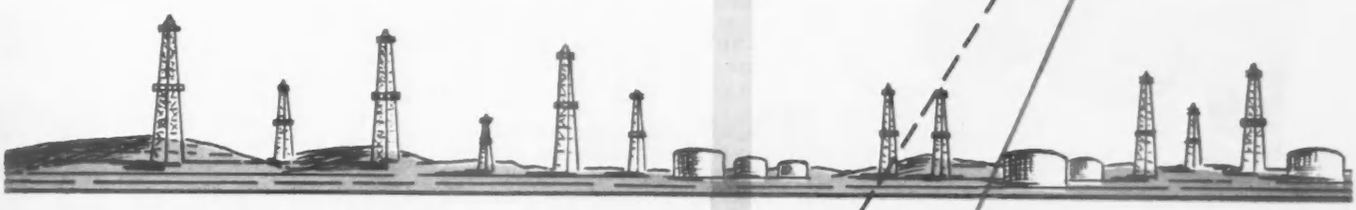
Three separate oil reservoirs assure positive lubrication and cooling. One reservoir provides lubrication for the main gears, another lubricates the main bearing and the hold down bearing, and the third lubricates the two pinion shaft bearings. All oil plugs and fittings are located in a convenient panel on the table skirt.

A fast, safe table lock is located near the driller's position. The lock engages a slot in the table skirt so that gears and bearings are protected from unnecessary loads and shocks when lock is engaged.

For additional information, write The Brewster Company, Shreveport, La., *referring to* WORLD OIL *item* 133.

TRET·O·LITE

CONSISTENTLY DEPENDABLE



QUALITY The quality of Tretolite Dehydrating Reagents is maintained at a consistently high level of excellence by time-proven methods of manufacture, continuous tests and careful inspection.
You can depend on Tretolite's uniform effectiveness.

SERVICE Tretolite Service is geared to the needs of oil producers, everywhere. Tretolite Service Engineers are located in every field. *When you call Tretolite, you get service.*

TRETOLITE COMPANY

Manufacturing Chemists

ST LOUIS 19, MISSOURI • LOS ANGELES 22, CALIFORNIA

DEHYDRATING | DESALTING

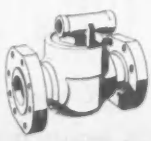
T 48-9

TANNER
HIGH PRESSURE
VALVES

WILL NOT STICK
and
REQUIRE *NO* LUBRICATION

The use of highly corrosion-resistant metals and special design entirely eliminates the possibility of the valve sticking or becoming hard to operate.

These valves are used in DRILLING, CEMENTING and PRODUCING. Available in either flanged or screwed ends. Valve sizes range from 1" to 4". Write for our catalog for complete details.



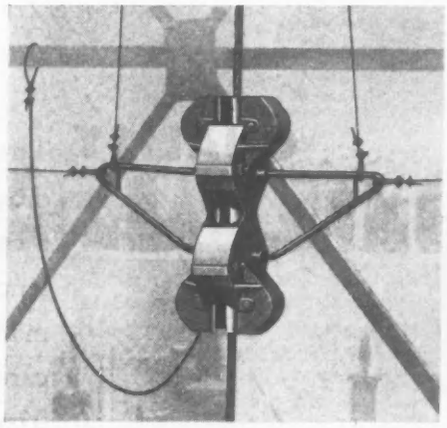
C. L. TANNER CO.
6887 Farmdale Avenue
North Hollywood, California

134—Wire Line Guide

This item supplements Patterson-Ballagh Division's data as shown on pages 3421-3488 of Composite Catalog.

This wire line guide properly stabilizes wire lines due to the greater over-all length and the large number of rollers. Uneven spooling and piling up on the drum is completely eliminated. The Roliguide handles both dry and lubricated lines. Each of the eight rollers rotates on two races of grease packed, over-capacity ball bearings. They absorb the vibration and whip of the wire line and transmit a greater portion of it to the guide body and the hanging assembly. Rollers are covered with tough, wear-resistant rubber and are completely housed within the body so that no oil can be thrown out on the crew or rig. Replacement parts are quickly and easily installed.

For additional information, write Patterson Ballagh Division, Byron Jackson Company, 1900 East 65th Street, Los Angeles, *referring to* WORLD OIL *item 134.*



135—Sump Pump

This item supplements the Gardner-Denver Company's data on pages 1372-1379 of Composite Catalog.

Designed to overcome one of the most common causes of pump failure—breaking of the pump shaft seal because of water pressure—a new sump pump, known as the VP-4 has been designed by the Gardner-Denver Company.

The VP-4 embodies a new principle, "top suction." Because of this feature, the oil seal of the VP-4 is subjected only to static pressure from depth of immersion when the pump is not in operation. When the pump operates, water cannot reach the oil seal on air motor.

The VP-4 sump pump is operated by a powerful vane-type air motor. The pump impeller of the closed type is made of exceptionally hard, abrasion resistant alloy. A built-in oiler lubricates all moving parts of the pump with oil, the oil chamber having one-quart capacity for 24 hours' normal operation. This feature of the VP-4 eliminates the grease fittings ordinarily used, which, when neglected, are a frequent cause of bearing failure.

For additional information, write the Gardner-Denver Company, Quincy, Ill., *referring to* WORLD OIL *item 135.*

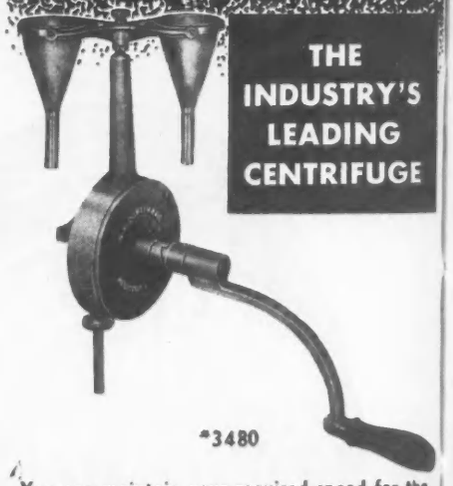
136—Side Wall Coring

This item supplements Halliburton Oil Well Cementing Company's data as shown on pages 1569-1640 of Composite Catalog.

This tool makes it possible to take up to 30 side wall cores at one time with good recovery. Core barrels are imbedded in the gun section, with six barrels per section. Five of these sections may be run in tandem, making the 30 cores per trip possible.

For additional information, write Halliburton Oil Well Cementing Company, Duncan, Okla., *referring to* WORLD OIL, *item 136.*

HEAVY DUTY-
RUGGED....



THE INDUSTRY'S LEADING CENTRIFUGE

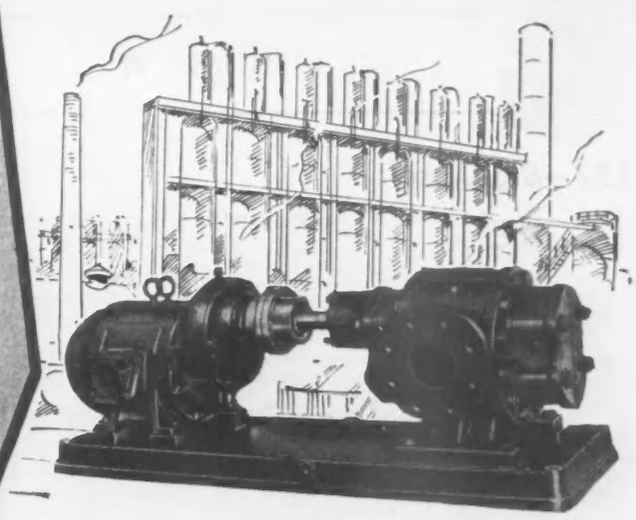
*3480

You can maintain your required speed for the full period of the test with much less effort. Curtin centrifuges, proven world-wide, are heavy duty, rigidly constructed, and extremely simple in design. Illustrated bulletin, giving full details, available upon request.

W·H·CURTIN & CO.
HOUSTON .... NEW ORLEANS

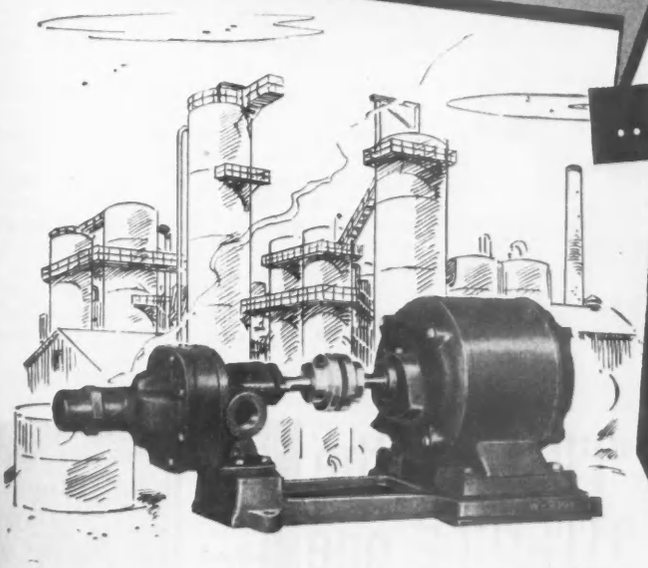
"OLD FAITHFUL"

That's what oil men call the Worthington GR Rotary Pump—a heavy-duty veteran of many years' service in refineries and throughout the petroleum industry. Always ready to do what's expected—and a good bit more—the GR's all-around usefulness is now increased by new inboard bearings and mechanical seals for over-hung drives. Fully described in Bulletin W-487-10B.



Worthington Rotary Pump, Type GR.
Capacities to 5,000 gpm. Pressures to 500 psi.
Available with steam or water jackets.

...AND...



Worthington Rotary Pump, Type GA.
Capacities to 51 gpm. Pressures to 100 psi.

"YOUNG FAITHFUL"

Latest and lightest additions to the Worthington Rotary Pump family, the new GA's are similar in general design and construction to the famous GR's—and equally smooth performers in their class. Bulletin W-484-B31 contains a detailed description.

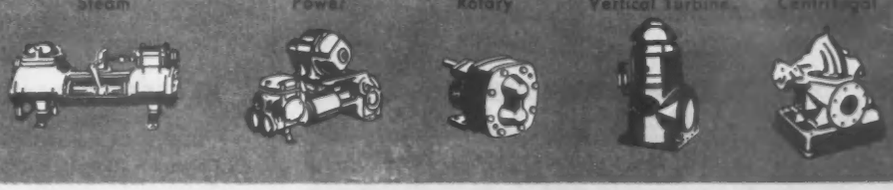
Both the GR and the GA show the advantages of Worthington's long, successful experience in custom-building pumps to refinery requirements. Identical in their outstanding efficiency and economy in many refinery pumping jobs, they join in proving *there's more worth in Worthington.*

Worthington Pump and Machinery Corporation, Reciprocating Pump Division, Harrison, N. J.

WORTHINGTON

P7-18

THE WORLD'S LARGEST MANUFACTURER OF PUMPS



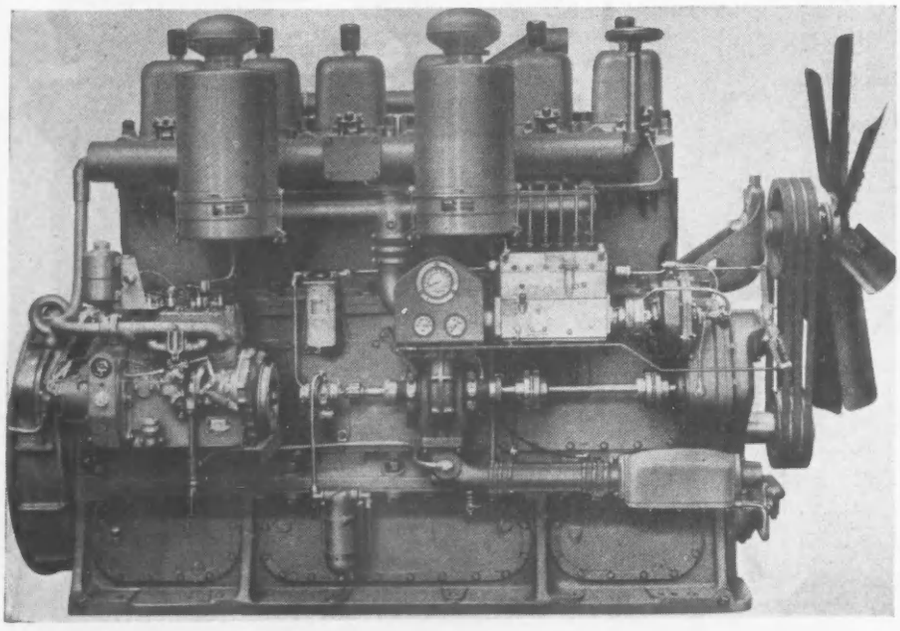
NEW EQUIPMENT

SUPPLEMENTING COMPOSITE CATALOG

137—Big Diesel

This item supplements Waukesha Motor Company's data as shown on pages 4222-4223 of Composite Catalog.

The Model 6-LRD Diesel engine, adapted to oil well drilling and other uses, occupies approximately the same space as its gas engine counterpart, but is entirely new from the crankshaft up. A large seven-bearing 5½ inch graphitic steel crankshaft is used, which is heat-treated and hardened to give crank pin and main journal hardness of 75-90 scleroscope index. The cylinder block is a husky one-piece casting into which are inserted the six hardened wet cylinder sleeves held in place by individual cylinder heads and head gaskets at the top, and the usual synthetic plastic rings at the base. Cylinders are of a special hardened alloy which test 400 Brinell.



The pistons are cast iron with six rings —four non-sticking wedge type, and two straight side oil control rings. A feature of the piston is the cooling of the piston crown by intermittent circulation of oil under pressure from the lubricating oiling system. Oil is led into the cavity beneath the piston crown through the oil ducts in the crankshaft, up the rifle-drilled connecting rod into the hollow piston pin. Through the piston pin, the oil is carried by a special duct communicating with the bearing boss and leading into the piston crown cavity.

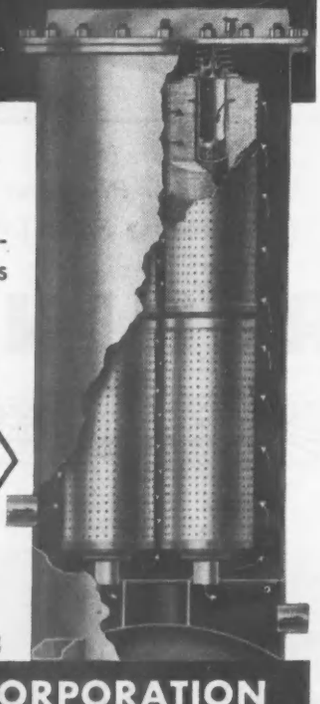
The engine as a power unit is equipped with large capacity waste-packed oil filters, large capacity fuel filters, built-in governor, American-Bosch injection system, and when so desired, can be equipped with an individual gasoline engine mechanical starting system.

For additional information, write Waukesha Motor Company, 703 South Wheeling, Tulsa, *referring to* WORLD OIL, *item* 137.

HILCO HYFLOW OIL FILTERS

For Lubricating and Fuel Oil

Maintenance of Diesel and Gas Engines



- Incorporating the finest features for simplicity and peak performance
- Uses factory packed or re-packable filter cartridges
- With or without heaters
- For straight mineral or detergent type oils

All metal Covered Filter Cartridges for SAFETY

Write for FREE literature and recommendations

Model HFC-8

THE HILLIARD CORPORATION

205 W. Fourth St., Elmira, N. Y.

"I'll take the WHITE one every time!"

WYTEFACE "A"

Trade Mark

Steel Tapes for the Oil Industry

WYTEFACE "A" Steel Tapes have raised black graduations on a crack-proof white surface. Easy to read in any light, from any angle. Designed for hard service. Resist rust and corrosion. Raised rims and markings protect the white background from abrasion from rails, pipe, rocks, concrete. Made in styles especially for Oil Riggers, Oil Gaugers and for general measurements. See your supply house, or write for details to Keuffel & Esser Co., Hoboken, New Jersey.

KEUFFEL & ESSER CO.

EST. 1867

NEW YORK • HOBOKEN, N. J.

Chicago • Detroit • Los Angeles

St. Louis • San Francisco • Montreal

What's in a name? PLENTY!

Have you ever stopped to analyze this name?...

THE NAME ***"Shaffer Combination Rotating Blow-Out Preventer and Stripper"*** **is a long one — *but actually it's not long enough to even begin to outline the many unique features incorporated into this unusually complete pressure control unit.***

FIRST, CONSIDER THE WORDS "COMBINATION BLOW-OUT PREVENTER AND STRIPPER": Unlike conventional pressure control equipment, this unit is BOTH a Blow-Out Preventer and a Stripper — combined into *one* compact unit. As a Blow-Out Preventer it maintains a *continuous* pressure-tight seal around *any* and *all* shapes and diameters* in the drill string — whether square, hexagon or octagon kellys ... flush or upset pipe, couplings, tool joints or drill collars. That in itself is a very important advantage!

AND NOT ONLY DOES IT MAINTAIN THIS SEAL CONTINUOUSLY, but it also adjusts itself *instantly* and *automatically* to varying shapes and diameters as they pass through the unit — *all without manual attention of any kind.* Therefore it is a "Stripper" in the fullest sense of the word — a Stripper that *automatically* maintains complete pressure control even while the drill string is raised or lowered through the unit—*and no special pipe handling procedures are necessary.* So that's another very important advantage!

HOW ABOUT THAT WORD "ROTATING"? It highlights still another vital feature, for this unit is not only both a Blow-Out Preventer and a Stripper, but it also maintains complete pressure control *while the drill string is rotating.* It even maintains a leak-proof seal around *all* types of kellys while they rotate — even square ones — without damage or wear on the Stripper Rubber!

You see, the kelly and Stripper Rubber rotate *together* — not one inside the other. This eliminates continuous wear and flexing of the Stripper Rubber, yet permits rotation to be maintained while the drill string is sealed off *at all times* against pressure emergencies. It's obvious that this is a very important advantage, too!

AND OF COURSE THAT WORD "SHAFFER" is mighty important because it tells you that this unit is backed by pioneers in the development of high pressure control equipment — an organization with a *quarter of a century* of leadership, experience and integrity behind every product it makes.

**Excepting such abnormally large diameters as reamer or bit.*

Actually the name is not long enough...

It doesn't indicate how the Shaffer Combination Rotating Blow-Out Preventer and Stripper is completely *automatic in its action, always maintaining its full pressure seal without manual operations of any kind. No valves to turn, nothing to tighten or loosen, no operations to remember — or forget — when pressure emergencies arise. It is* always *sealed around the drill string!*

And the name doesn't even hint at such other vital features as the unique bearing design *that assures smooth wobble-free rotation without maintenance ... or the pre-packed* lifetime *bearing lubrication ... or the special barrier of expandable steel latches that safeguard the Stripper Rubber against damage by large diameters, and against extrusion by high pressures ... or the simple way in which such large tools as bits and reamers can be readily passed through the unit by simply pulling a latch and rotating the bonnet 1/6th turn to open the body to full casing diameter.*

In fact, although we have mentioned only a few of the many really unique features combined into the Shaffer Combination Rotating Blow-Out Preventer and Stripper, you can readily see that the name isn't half long enough. Before you invest in any pressure control equipment, why not let us give you the *complete* story on this versatile, trouble-free, highly-efficient Shaffer product?

25 YEARS OF OIL TOOL LEADERSHIP

SHAFFER

HIGH PRESSURE DRILLING AND CONTROL EQUIPMENT • FISHING TOOLS THAT EXCEL

SHAFFER TOOL WORKS: Brea, California • California Service Shops: Santa Fe Springs and Taft
HOUSTON, TEXAS, 6006 Navigation Blvd. • ODESSA, TEXAS, 1925 West Second Street
OKLAHOMA CITY, OKLAHOMA, Acme Oil Tool Company, 1001 S. E. 29th Street
EXPORT SALES OFFICE: Shaffer Tool Works, 500 Fifth Avenue, New York, N. Y., U.S.A.

Write for your free copy of the Shaffer Catalog. See pages 3843 to 3894 of your 1948 Composite Catalog for data on the full Shaffer line.

NEW EQUIPMENT

SUPPLEMENTING COMPOSITE CATALOG

138—Connector

This item supplements the Byron Jackson Company's data as shown on pages 797-896 of Composite Catalog.

Designed for operators who need maximum clearance in portable and mast-type drilling, the compact 22½-inch "Stubby" connector has as optional equipment (1) a bail or (2) suitable adaptors for direct-connection to popular makes of blocks. A clevis, for sidehook attachment, is extra equipment for use with single bail casing tools. When adapted to a popular make 36 x 24-inch block, the overall length is only 70⅞ inches.

A new housing design, with sturdy link supporting ears, fully encloses the working parts. The shank is made from a forged and heat treated piece of alloy steel and has no load-carrying threads. While the sub-shank and the sub-shank nut are threaded they are subjected only to the down thrust of the low-stress relief springs. The two springs give 6 inches of soft spring travel, floating action that eliminates exact spotting of the travelling block, provides greater ease in handling heavy loads and eliminates galling pipe threads. A 30-degree pendulum action of the housing, plus the added pendulum action between the adaptor and the shank, provides maximum flexibility between the connector and the travelling block.

For additional information, write Byron Jackson Company, Oil Tool Division, Box 2017 Terminal Annex, Los Angeles 54, *referring to* WORLD OIL *item 138.*

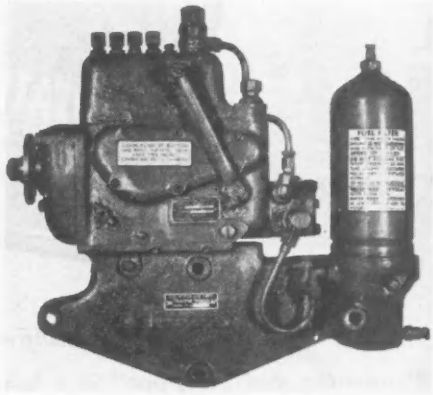
139—Fuel Injection Pump

This item supplements the International Harvester Company's data as shown on pages 2037-2040 of Composite Catalog.

A field replacement package unit has been designed containing a new single-plunger International Diesel fuel injection pump for replacing the older four-plunger pumps found on series "35" and series "40" diesel engines. New high-pressure fuel lines and all necessary accessories are included. No modifications are required to install the new unit. Cost of the unit is said to be less than the expense of a major overhaul on the old pump.

Features of the single-plunger pump include faster governor action and more accurate fuel metering and injection.

For additional information, write International Harvester Company, 180 North Michigan Avenue, Chicago, *referring to* WORLD OIL *item 139.*



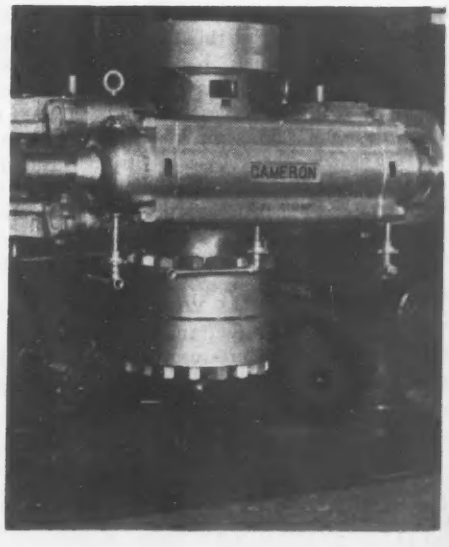
140—Blowout Preventer

This item supplements Cameron Iron Works, Inc.'s data as shown on pages 905-968 and 3018-3019 of Composite Catalog.

In keeping with the trend toward heavier equipment to handle the ever-increasing pressures encountered in modern deep drilling, is the "QRC" pressure-operated blowout preventer for 10,000 pounds working pressure, 15,000 pounds test pressure, available only in 10-inch size.

Features of the blowout preventer are quick ram change, high ratio of closing pressure to well pressure, compactness, and weight and space saving design.

For additional information, write Cameron Iron Works, Inc., Box 1212, Houston, *referring to* WORLD OIL *item 140.*



This WISCONSIN Air-Cooled ENGINE

. . . is on the JOB 24-Hours a Day!

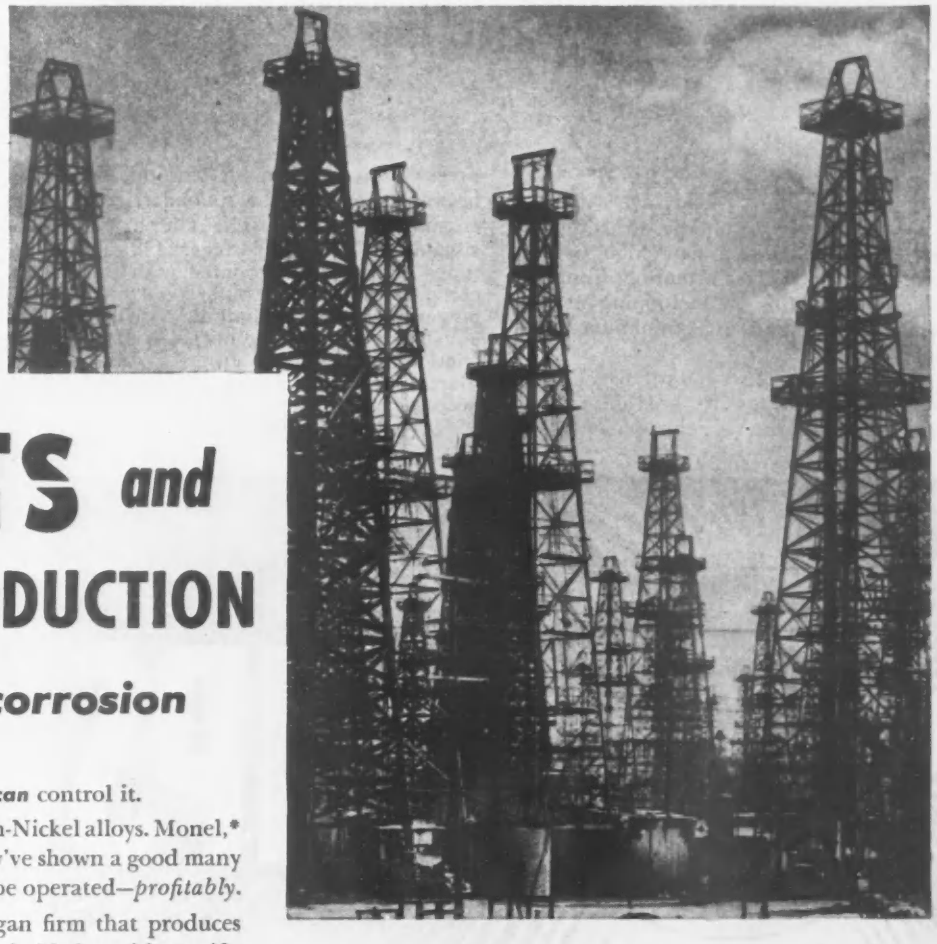
It takes heavy-duty stamina and all-weather dependability for an engine to keep plugging away, 24 hours a day, out in the open . . . as this Model VE-4 Wisconsin Air-Cooled Power Unit is doing. You'll find it on the job, any day, any hour, pumping an oil well in Central Oklahoma . . . for a concern that has a full appreciation of the value of heavy-duty design and construction, operating and maintenance economy, and weatherproof serviceability.

Incidentally, another point worth considering is the fact that this Wisconsin Engine is operating on natural gas.

For your power jobs between 2 and 30 hp., specify Wisconsin Air-Cooled Engines. You'll be glad you did if you do.

WISCONSIN MOTOR Corporation
MILWAUKEE 14, WISCONSIN
World's Largest Builders of Heavy-Duty Air-Cooled Engines

WRITE TO HARLEY SALES CO.
510 Atlas Building, Tulsa, Oklahoma
M & M Building, Houston, Texas
Oil field distributors for Wisconsin Engines and all types of utility units.



How YOU can

CUT COSTS and INCREASE PRODUCTION

...by controlling corrosion

You can't stop corrosion. But you ***can*** control it.

Install equipment made with high-Nickel alloys. Monel,* for example. Or "K"* Monel. They've shown a good many producers that corrosive wells can be operated—*profitably.*

Take the experience of a Michigan firm that produces from the Sylvania formation a chemical brine with specific gravity of 1.28. At a depth of 2,400 feet, the pump they were using just didn't stand up. *But trouble ended when they installed a Reda pump equipped with a "K" Monel shaft and Ni-Resist diffusers.*

Then consider the story of this well in Louisiana. It had *plenty* of oil below the surface—but would only make gas on a ⅛" surface choke with 3,000 pounds pressure. Freezing of surface flow lines and connections was frequent. The allowable couldn't be produced.

After the operator installed an Otis Removable Bottom Hole Regulator made of "K" Monel, surface pressure dropped to 1,350 psi. Freezing stopped. Gas-oil ratio was cut to a point where almost no oil was wasted. The regulator stayed in the tube 57 months, produced 869,839 barrels before it was pulled for inspection. *It was found in first-class condition.*

Of course, corrosion resistance is only one quality that contributes to the dependability of equipment like this. Extra strength, hardness, toughness or resistance to wear and abrasion may also be vital. *In high-Nickel alloys, you get the combination of properties you need.* Through years of use in the toughest areas of the mid-continent district, Monel and "K" Monel have proved especially well adapted to combat harsh conditions.

Monel, in addition to being rustproof and highly resistant to sour crudes, withstands the cutting action of high-pressure gas, provides unusually good resistance to erosion and abrasion by entrained solids. **"K" Monel** brings you those same characteristics *plus* extra strength and hardness. It is non-magnetic; by heat treatment its tensile strength can be developed to 140-170,000 psi, its hardness to 265-320 Brinell.

Both Monel and "K" Monel are used for parts subject to alternating stresses in the presence of corrosives. Their retention of good fatigue strength is particularly evident in extended equipment life.

The full story of how you can put these and other INCO Nickel Alloys to work for you is contained in our new, illustrated booklet, *Controlling Corrosion in Petroleum Production Equipment.* It brings you typical performance and service stories of Nickel Alloys in a variety of corrosive uses. It discusses the important factors in reducing maintenance and replacement costs. There are sections dealing with exploration and drilling, pumping, and gas control.

The booklet tells, too, how you can get free technical advice on the selection of materials for severe service, and contains a listing of valuable Technical Bulletins that are available to you on request. Write for your copy—*now.* We'll get it into the next outgoing mail. *Reg. U. S. Pat. Off.

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street, New York 5, N. Y.

EMBLEM OF SERVICE
INCO
TRADE MARK

MONEL..."K" MONEL...

Your partners in PROGRESS

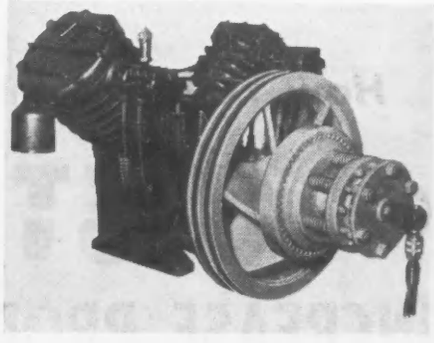
OTHER NEW AND IMPROVED *Equipment*

141—Air Clutch

A completely automatic air compressor clutch reaches a new high in efficiency, requiring no attention from the operator, starting and stopping at any desired maximum and minimum pressure.

Intended for heavy duty use, it has six strong springs to provide simple, positive, automatic engagement. Air pressure acts on a diaphragm, when pressure operates the unloader, to disengage the clutch. The clutch is designed to be easily accessible at all times and may be mounted with the air compressor at the outer end of the power unit output shaft and driven by a V-belt pulley on the output shaft. The friction lining wears up to a full one-fourth inch before any replacement is necessary.

For additional information, write Wichita Falls Foundry and Machine Company, Wichita Falls, Texas, *referring to* WORLD OIL *item* 141.



142—Magnaglo

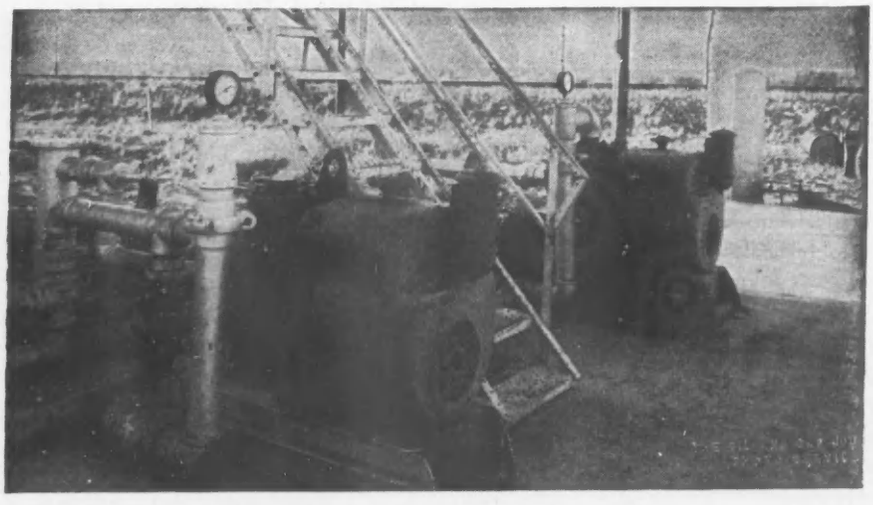
Improved inspection and reduction of failure is obtainable when Magnaglo is used in the field or machine shop to locate cracks in threads of subs or drill collars. Magnaglo consists of inspection particles which are fluorescent and brilliantly outline the cracks when illuminated by black light.

Parts are properly magnetized and the special liquid bath is applied by spraying on with an applicator. A black light is then introduced under a hood which eliminates daylight, and the operator examines the threads for cracks. Any cracks are clearly shown marked by yellow-green glow against a dark blue background. By this method the very fine cracks in the bottom of sharp "V" threads are readily located, and small fatigue cracks which may be incipient failures are quickly detected.

For additional information, write Magnaflux Corporation, 6900 Northwest Highway, Chicago 31, *referring to* WORLD OIL *item* 142.

CMC PUMPS

Utility Dual Prime Model 420 4" Pump — 20 H. P.



These two Model 420 Pumps loading Lub-Oil down in Texas is typical of the many services rendered by CMC Pumps for the oil industry. Ask our engineers to help you with your specific pumping problem.

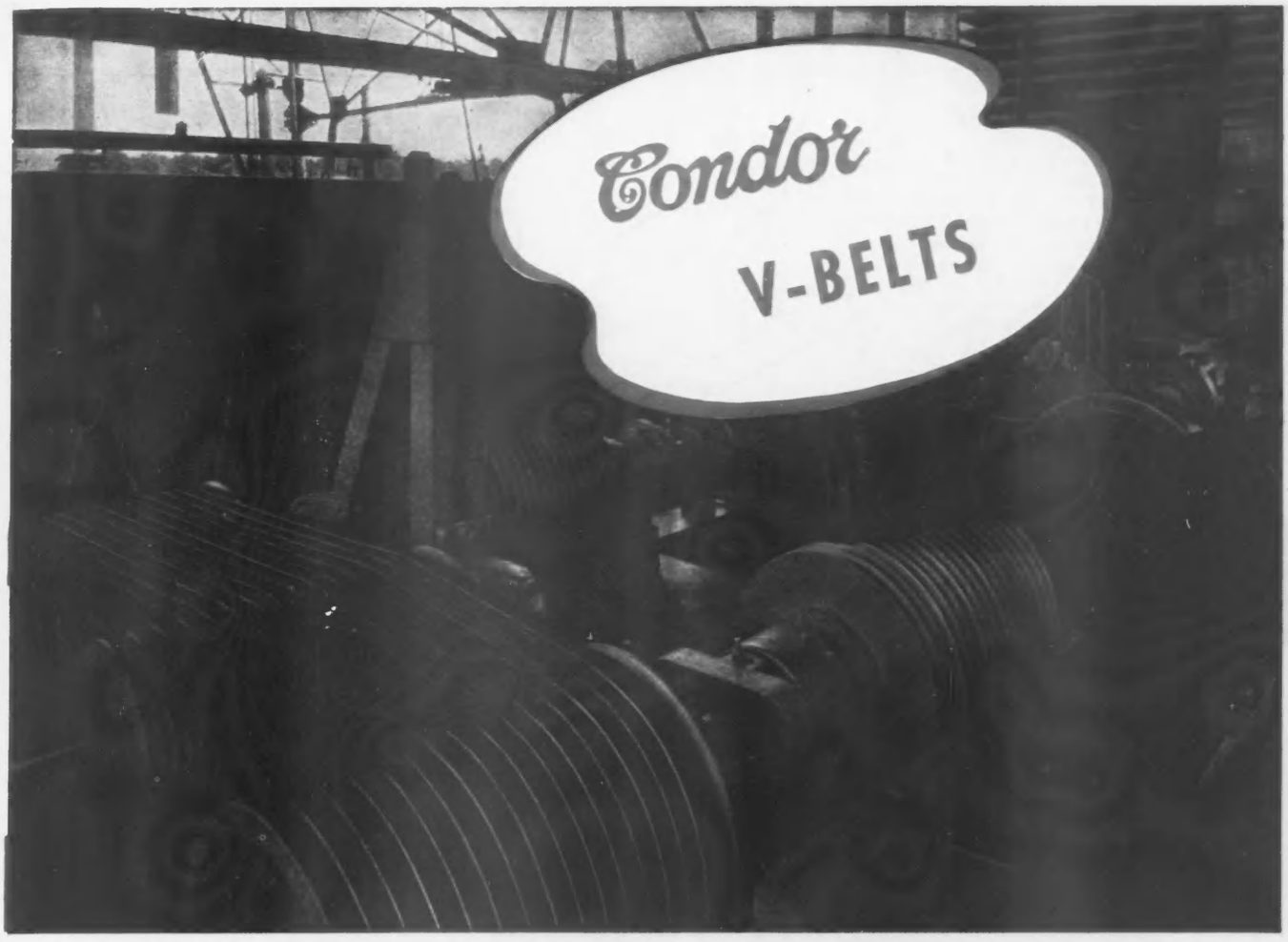
CONSTRUCTION MACHINERY CO'S.

Specializing in High Pressure centrifugals, Dual Prime centrifugals and Diaphragm pumps for the oil fields.

WATERLOO, IOWA

1903 Blodgett St., Houston, Texas

TELEPHONE HADLEY 3988



Cut Costs on Diesel Rigs

Manhattan's method of pre-stretching the strength members of Condor V-Belts builds balanced V-belt teams that pull together to cut your belting costs. Every belt pulls its share so no belt takes destructive strains. There is no slippage due to excessive stretch.

Strength members impregnated and covered with Flexlastics insure uniform, cool-running, power delivery. Plenty of cushion assures long wear. Rugged side wall construction gives positive traction grip for maximum power. Heavy duty covers are weather-proof, yet flexible and smooth-running.

You can also profit from the advantage of Manhattan V-belts in Oil-Proof and Non-Spark constructions.

Whatever your requirements, your rigs will run smoother if you equip every part with Manhattan—Rotary Hose, API Flat Transmission Belts, Condor V-Belts, etc. Try Manhattan and compare for quality.

("Flexlastics" is exclusive with Manhattan)

Keep Ahead with Manhattan

RAYBESTOS R M MANHATTAN

RAYBESTOS-MANHATTAN INC.

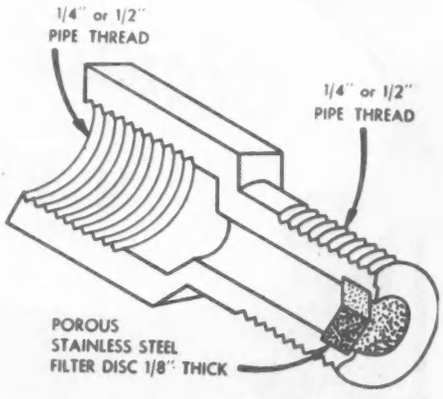
MECHANICAL RUBBER PRODUCTS — RUBBER COVERED EQUIPMENT — FRICTION MATERIAL — ASBESTOS TEXTILES
PACKINGS — POWDERED METAL PRODUCTS — ABRASIVE & DIAMOND WHEELS — BOWLING BALLS

MANHATTAN RUBBER DIVISION **PASSAIC, NEW JERSEY**

143—Pressure Snubbers

Equipoise snubbers eliminate pressure gauge fluctuations caused by pressure pulsation and vibration. By completely smoothing out pressures they cause gauge to indicate steady average pressures, protect the indicator mechanism against undue shock and wear, and at the same time permit accurate indication of changes in pressure.

An important feature of these snubbers is the porous stainless steel filter disc. The disc provides a relatively large filter surface which effectively prevents clog-up in pressure gauge service. Specially designed filter discs are available for air, oil, water, mercury, etc.



Mechanical design permits easy installation of the snubber into any pressure line for instrument protection; for clarification of small quantities of fluids; as a metering device; and as a protective medium for preventing mercury losses from manometers when manometers are over-ranged temporarily.

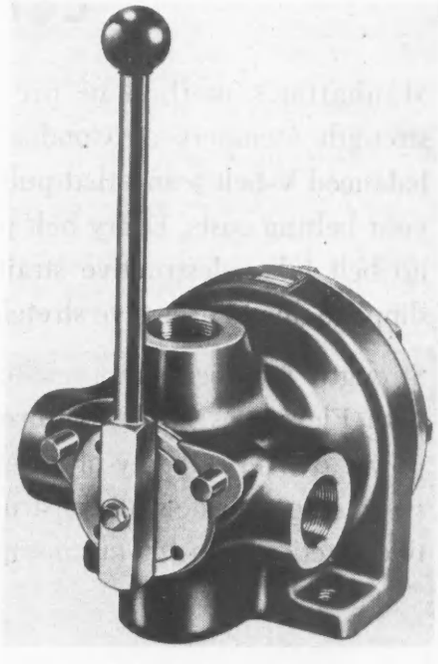
Maximum differential pressure rating of the standard types is 500 pounds per square inch. Snubbers for use up to 5000 psi differential can be supplied.

For additional information write Equipoise Controls, Inc., 100 Stevens Avenue, Mt. Vernon, N. Y., *referring to* WORLD OIL *item 143.*

144—Selector Valve

Features of selector valve No. 8298 are low handle load, ball bearing construction, and rugged stops and balanced detents for all three operating positions. A force of only 35 pounds on the 12-inch handle actuates the valve at 5000 psi pressure.

Designed for corrosion-resistant service with water, oil or gas, this valve has a forged steel body with heavy-duty construction throughout. It employs Saval's patented principle which provides a metal-to-metal seal that is self-aligning and automatically compensates for wear. Valve is not critical to dirt because foreign materials are wiped away instead of lodging between surfaces.

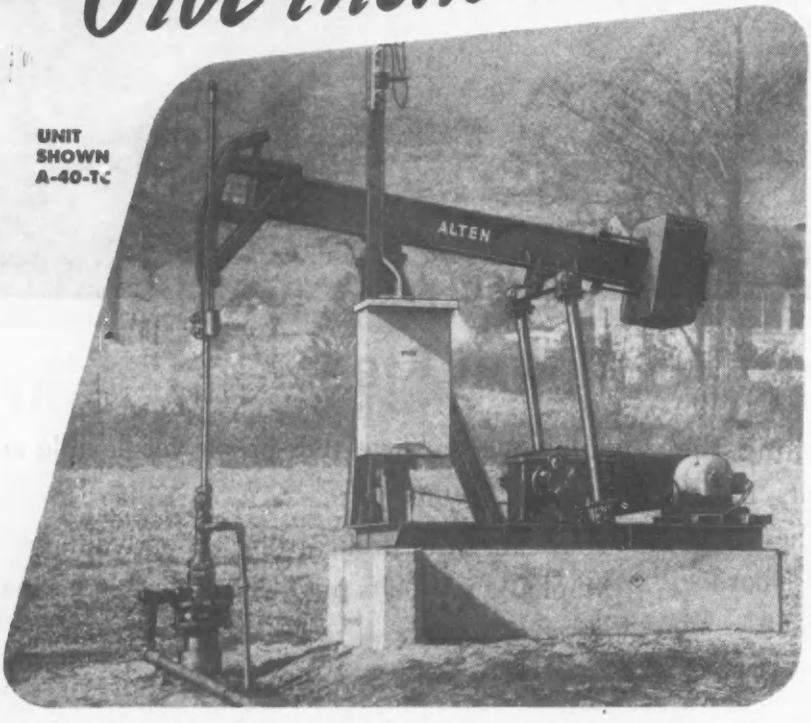


The valve has only one basic moving part. It may be serviced without removing from lines and requires no lubrication or packing adjustment throughout its life.

For additional information, write Saval Company, 1915 E. 51st Street, Los Angeles 11, *referring to* WORLD OIL *item 144.*

ALTEN PUMPING UNITS

Give them a trial!



Quality Features Include:

★ High Capacity Double-Reduction Gear Reducer Chrome-Nickel Steel Pinions. Hardened Steel Gears. Helical Shaved Gearing. Roller Bearing Equipped Throughout.

★ Double-Row, Spherical Self-Aligning Wrist Pin and Equalizer Roller Bearings.

★ Rigid, All-Welded, Structural Steel Samson Post and Frame

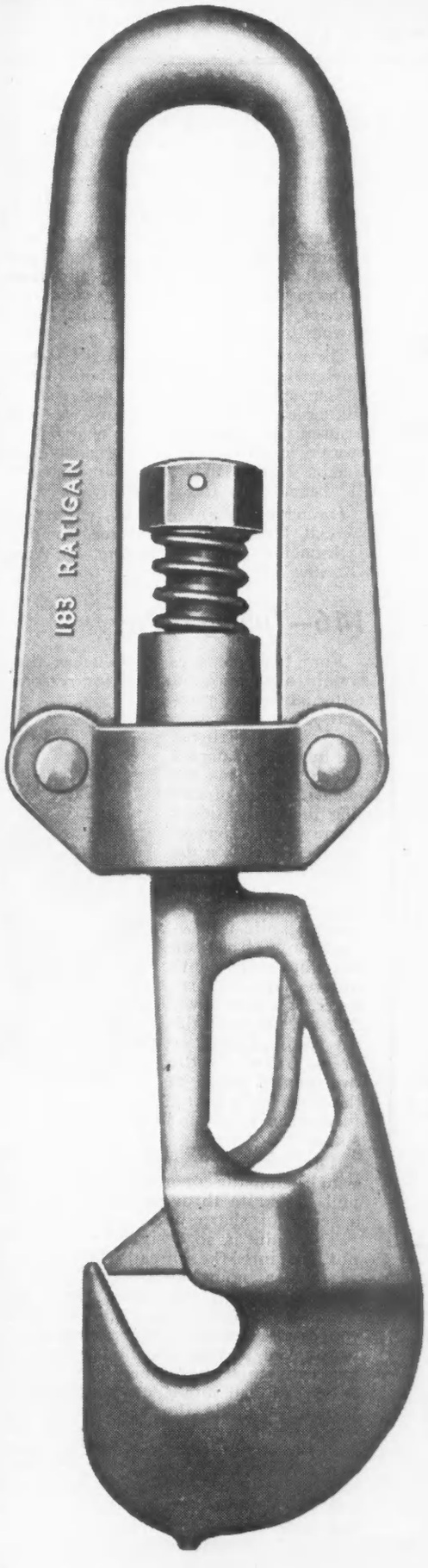
★ Adjustable Stroke Lengths, Effective Balancing, For Use With Gas Engine or Electric Motor.

★ High Efficiency. Weatherproof Construction.

SEND FOR *New* CATALOG

Complete Pumping Unit Specifications. Also illustrates Alten Casing Heads, Stuffing Boxes, Stop Cocks and hundreds of other production items.

ALTENS
FOUNDRY AND MACHINE WORKS, INC.
LANCASTER, OHIO
Established 1889
Sold Through Dealers Everywhere



Ratigan Products Are Illustrated and Described in the 1948 Composite Catalog.

RATIGAN

NO. 183

Extra Heavy, Spring Type

SUCKER ROD HOOK

WEIGHT–85 POUNDS • CAPACITY–60 TONS

The Ratigan No. 183 Sucker Rod Hook will balance the stand of rods in the derrick, so that one man can lift it or pull it down, as desired. Occasionally, when the operator is running rods into the tubing, the stand may not come down the required distance. When this occurs, the man wrenching the rods easily can pull the stand down the required distance. In the event the operator should allow too much slack when he sets back on the elevator, the spring in the hook takes up his slack, holding the stand straight–an important feature that is widely recognized by all operators.

The extension of the point beyond the front of the body is another valuable feature which makes it practically impossible for the man "hooking on" to miss placing the bail on the hook.

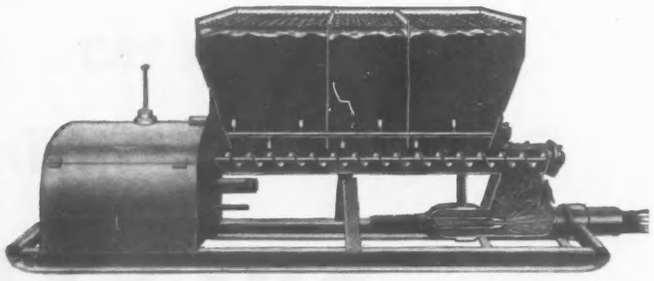
J. P. RATIGAN, INC.

1213 Santa Fe Avenue, Los Angeles 21, California

Ratigan Products Are Sold Through Leading Supply Stores

145—Mud Mixing Machine

A mud mixing machine, which operates with the mud pump connected to an inlet on its mixing chamber, assures uniform mixture and weight of drilling mud through controlled feed from its hopper to a screw conveyor and the utilization of a high pressure spray of fluid



through a nozzle, injected by the mud pump into its mixing chamber. The conveyor screw is so designed that amounts of material fed from each of its three compartments are equal. The screw shaft as well as a secondary paddle shaft installed above it to prevent materials from clogging the screw are mounted in self-aligning roller bearings. The high pressure spray and the resulting turbulence in the mixing chamber assure positive mixture of fluid and dry materials before flowing into the suction pit.

The machine may be powered by either an electric motor or steam turbine to drive a four-speed transmission designed for mixing capacities to meet any condition. Transmission gears are fully enclosed and operate in an oil bath. The complete unit weighs 1125 pounds and is mounted on "I" beam skids for portability.

For additional information, write Commercial Mud Mixing Machine Company, Jacksonville, Texas, *referring to* WORLD OIL *item* 145.

146—Tubing Cutter

For two decades, producers have sought a practical method for restoring water intake well pressure after corrosion has eaten through the the tubing. A patented tubing cutter has the unique feature of cutting the pipe inside a collar without damaging the threads on the collar itself.

The mechanism which contains the cutting knife is lowered on a braided wire line to the depth ordered by the producer. It is then slowly drawn up until the knife engages the break between the two ends of tubing in the collar. A spring forces the knife to snap into the break space.

The line is then pulled taut with the winch and the operator and assistant pull the knife through the tubing with a series of sharp jars.

The knife is so designed that it does not cut into the threads but when it reaches a point above the collar, it breaks through the tubing and trips. The mechanism is then pulled to the top of the hole and the tubing can be unscrewed leaving the undamaged collar ready to receive a new joint of pipe. A special bell nipple has also been designed to guide the new tubing to a quick union with the collar in the hole.

If the operator overshoots the ordered depth in lowering the tool into the hole, the mechanism can be lowered through the McGreagor seat at the bottom of the well. Here the knife automatically trips and the mechanism can be returned to the top of the hole to start over again.

For additional information, write McGralba Service Company, 126 South Main Street, Wellsville, N. Y., *referring to* WORLD OIL *item* 146.

Jefferson Malleable Unions

STYLE "B"

JEFFERSON Style "B" three-piece flange union is made with brass-to-iron and iron-to-iron seats. Being made of highly refined AIR FURNACE iron, it assures you of lightweight construction, perfect ball joint, and positive seating arrangement, whether or not in alignment.

★ ★ ★

HYDRAULIC PRESSURE RATING

Sizes	Test Pres.	O. W. G.	S.W.P.-550 Deg.
½" thru 4"	2000#	800#	250#
5" and 6"	1200#	500#	250#
8" and 10"	1000#	400#	250#

Malleable iron used in all JEFFERSON unions meets ASTM-4733, Grade 35018—M. T. 53000 Lbs., giving 75%-more elongation 50%-more impact value and is 30%-stronger than cupola malleable iron.

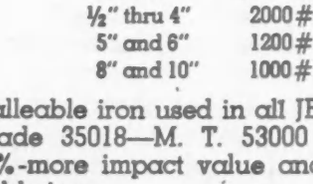
Obtainable through your jobber

Jefferson Union Company, Inc.

691 West 26th St.,
New York 1, New York

71 Gooding St.,
Lockport, New York

31 Fletcher St.,
Lexington, Mass.



PELCO

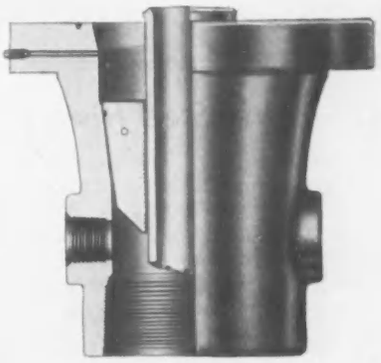
Welding Saddles

Specify PELCO

IMMEDIATE DELIVERY
OUTLET (OR NOZZLE) SIZES ¼" x 16"
HEADER (OR LINE) SIZES UP TO 36"
Order Through Your Favorite Supply House

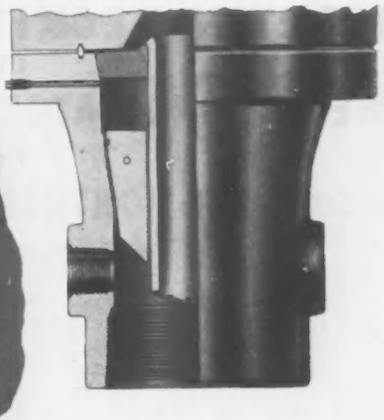
PELICAN WELL TOOL & SUPPLY CO.
P. O. Drawer 1108 Shreveport (84), La.

with RECTORHEAD it's



Set

Type RH casing head with pipe suspended on slips. After cutting-off casing, welding ring is placed in seat and you are ready to weld.



Seal

In less than one hour your regular welder can make this welding ring and pipe weld. API ring gasket at junctures of welding ring and head body completes the "RING OF STEEL" seal between casing string.

Safe

There are no wet spots in the RECTORHEAD Christmas Tree. Its "RING OF STEEL" seals are permanently leak-proof . . . won't deteriorate . . . won't freeze or burn out . . . never require changing . . . withstand anti-corrosion chemicals. It's PERMANENT.

They're sealed with a "Ring of Steel"

RECTORHEAD weld plus API ring gasket gives you the strongest, safest, easiest-to-install between string seals of any well head hook-up. This "ring of steel" seal is permanently leak-proof. It requires no maintenance or replacement. It protects your well investment for the life of the well . . . safeguards against pressure equalization.

Welds, for the "Ring of Steel" seals can be made by your regular welder on any grade of pipe. The weld and welding ring are never subjected to strain or tension.

Specify RECTORHEAD "Ring of Steel" seals on your next well for complete protection of your investment.

RECTOR WELL EQUIPMENT CO., INC., Fort Worth, Texas

FORT WORTH PLANT: 1100 N. Commerce St. HOUSTON PLANT: 2215 Commerce St.

Representatives in All Active Fields

RECTORHEAD

MAKING THE OIL INDUSTRY SAFER!

147—Marsh Steel History

Designed to give information about facilities and organization is a new bulletin, "The Story of Marsh Steel Corporation." In the 20 pages of the publication is a discussion of the importance of the steel warehouse distributor. A pictorial section takes the reader on a tour of the warehouse and plant at North Kansas City, Mo. A list of steel stocks maintained at the plant is included.

For a copy of this bulletin, write Marsh Steel Corporation, North Kansas City, Mo., *referring to* WORLD OIL *item 147.*

148—Power Slips

Speed-trip power slips are fully described in 12-page illustrated folder.

For a copy of this folder, write Byron Jackson Company, Oil Tool Division, Box 2017 Terminal Annex, Los Angeles, 54, Calif., *referring to* WORLD OIL *item 148.*

MARTIN-DECKER | *National* IDEAL

TYPE "D"

WEIGHT INDICATOR & WIRE LINE ANCHOR

Combine

DRILLING CONTROL with LINE ANCHORING

Safe — Accurate — Convenient — Economical

The IDEAL Type "D" Wire Line Anchor and the MARTIN-DECKER Type "D" Weight Indicator combine the elements of (1) the wheel (for anchoring the wire line) and (2) the lever for measuring the load on the wire line. A gauge at the driller's position registers the force on the lever which is transmitted to the gauge through the hydraulic pressure unit. The load on the hook is shown directly in pounds by the gauge.

Gives The Driller

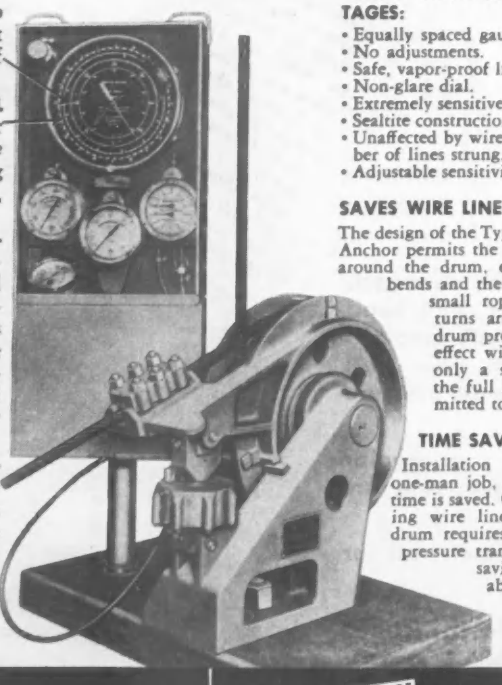
A NET-WEIGHT-ON-BIT WEIGHT INDICATOR

(Set the NET-WEIGHT-ON-BIT Dial on zero and read the Bit Weight directly in thousands of pounds.)

A CONVENTIONAL WEIGHT INDICATOR for *Total Weight of the Drill String*—showing tight holes, stuck pipe, load on derrick, etc.

A VERNIER WEIGHT INDICATOR gives the engineer a permanent record of each 24 hours of operation. The Gauge is placed in front of the driller where the slightest change in hook load or bit weight is instantly revealed.

HYDRAULICALLY OPERATED—positively unaffected by atmospheric changes. Dead line whip can neither affect Weight Indicator reading nor damage the instrument.



OTHER OUTSTANDING ADVANTAGES:

- Equally spaced gauge graduations.
- No adjustments.
- Safe, vapor-proof light.
- Non-glare dial.
- Extremely sensitive.
- Sealtite construction.
- Unaffected by wire line size or number of lines strung.
- Adjustable sensitivity.

SAVES WIRE LINE

The design of the Type "D" Wire Line Anchor permits the line to be moved around the drum, eliminating sharp bends and the use of numerous small rope clamps. Three turns around the anchor drum provide a coil brake effect with the result that only a small fraction of the full line pull is transmitted to the clamp.

TIME SAVED TWO WAYS

Installation being a simple one-man job, initial rigging up time is saved. Changing or moving wire line on the anchor drum requires no handling of pressure transformer, thereby saving hours of valuable drilling time.

THE NATIONAL SUPPLY CO.
GENERAL SALES OFFICES: TOLEDO, OHIO
DIVISION OFFICES:
DENVER • FORT WORTH • PITTSBURGH • TULSA • TORRANCE
EXPORT:
NATION SUPPLY EXPORT CORPORATION, 30 ROCKEFELLER PLAZA, NEW YORK, N. Y., U. S. A. • RIVER PLATE HOUSE, 12 SOUTH PLACE, LONDON, E. C. 2.

MARTIN (HOME OF THE WEIGHT INDICATOR) **DECKER CORP.**
LONG BEACH, CALIFORNIA
SAN JOAQUIN VALLEY:
T. J. CULLEN, BAKERSFIELD, CALIFORNIA
MID-CONTINENT DISTRIBUTOR:
REED ROLLER BIT COMPANY, HOUSTON, TEXAS

149—Drill Collars

Bulletin No. 353, describes the qualities of Ideal drill collars and kellys in terms of modernized manufacturing facilities, which include heat treating equipment for collars up to 54 feet long. Profuse illustrations of the new production line and complete specifications for collars and kellys are included.

For a copy of this bulletin, write The National Supply Company, Box 899A, Toledo, Ohio, *referring to* WORLD OIL *item 149.*

150—Weco Catalog

A 148-page catalog which includes complete descriptions and prices on all WECO, Chiksan and Okadee products includes prices on all products. The three catalogs, plus an individual 16-page price booklet and latest resale discount sheets, are bound into a black binder.

For a copy of this catalog, write Well Equipment Manufacturing Company, Houston, *referring to* WORLD OIL *item 150.*

151—Acetylene Generator

"Welderz Frend," a six-page bulletin, describes a portable acetylene generator which makes removal of the hopper unnecessary more than once in several years. Specifications and price list are included.

For a copy of this bulletin, write Welderz Frend Generator Company, Lubbock, Texas, *referring to* WORLD OIL *item 151.*

152—Side Door Chokes

"Removable Side-Door Chokes," Bulletin 48-105, is a 16-page booklet, printed in four colors. It contains 29 illustrations covering all standard applications of removable side-door chokes and supplementary equipment in the completion and production of single and two-zone wells.

For a copy of this booklet, write Otis Pressure Control, Inc., 6600 Denton Drive, Dallas, *referring to* WORLD OIL *item 152.*

153—Oil Heaters

Bulletin 482 illustrates and describes the engineering characteristics as well as the installation features of the Brown fintube tank suction heaters and line heaters for a wide range of pressure applications.

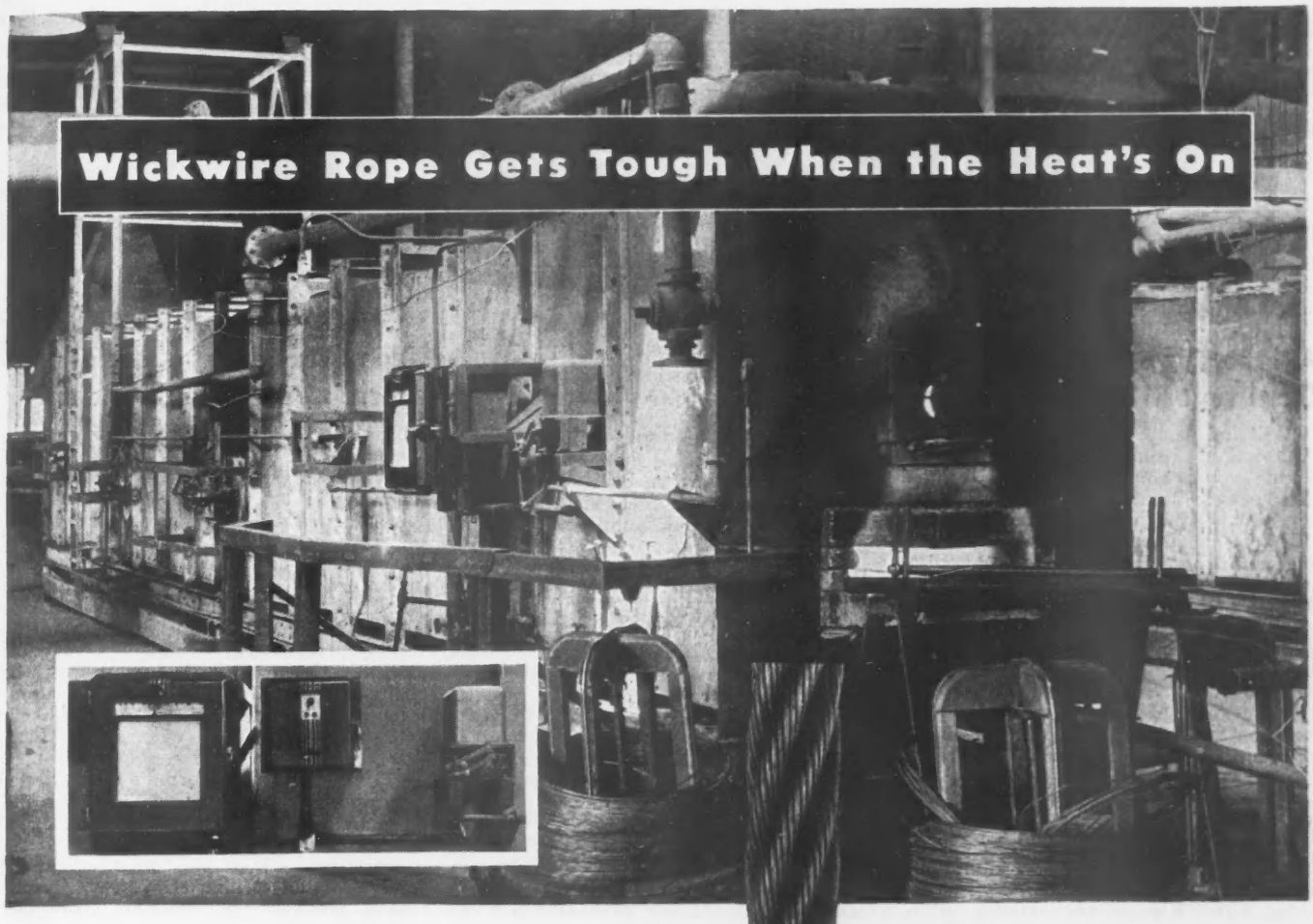
For a copy of this bulletin, write The Brown Fintube Company, Elyria, Ohio, *referring to* WORLD OIL *item 153.*

154—Induction Motors

Large induction motors of the squirrel cage wound rotor, bracket bearing, and pedestal bearing types are described in a new 24-page bulletin. Information includes electrical characteristics, representative full load power factors, and approximate range of starting torques of squirrel cage motors larger than 200 horsepower.

For a copy of this bulletin, write Allis-Chalmers Mfg. Company, Milwaukee 1, Wis., *referring to* WORLD OIL *item 154.*

Wickwire Rope Gets Tough When the Heat's On



Traveling through a fiery patenting furnace changes the microstructure of high carbon steel—removes the effect of cold drawing, permits further processing and makes rope wire exceedingly strong and tough.

Temperature and rate of cooling have an important bearing on the size of grains developed in patenting, and grain size determines to a large degree, the physical properties of the wire. That's why the patenting furnaces at Wickwire's newly enlarged Rope Mill have controls so accurate that, even when operating at 1700°F., they anticipate a 5° drop or rise in temperature and automatically regulate the burners.

Accurate patenting temperature is one of many quality controls used in making Wickwire Rope. Because it contributes to rope strength and toughness, it is as important to you as the service of Wickwire distributors and rope engineers who are always ready to help solve your wire rope problems and to supply the right rope for your needs.

For the utmost in performance, safety and long life, specify Wickwire Rope. It is available in all sizes and constructions, both regular lay and WISSCOLAY *Pre*formed.

THIS 82-PAGE BOOK ON WIRE ROPE IS FREE —WRITE FOR YOUR COPY TODAY!

Thousands of wire rope users have found that the information packed in the pages of "Know Your Ropes" has made their work easier. It's full of suggestions on proper selection, application and usage of wire rope. It's easy-to-read and profusely illustrated. For your free copy, write: Wire Rope Sales Office, Wickwire Spencer Steel, Palmer, Massachusetts.

WICKWIRE ROPE

CF&I & SUBSIDIARIES

A PRODUCT OF WICKWIRE SPENCER STEEL DIVISION OF THE COLORADO FUEL AND IRON CORPORATION

WIRE ROPE SALES OFFICE AND PLANT—Palmer, Mass. **EXECUTIVE OFFICE**—500 Fifth Avenue, New York 18, N. Y.

SALES OFFICES—Abilene (Tex.) • Boston • Buffalo • Chattanooga • Chicago • Denver • Detroit • Emlenton (Pa.) • Philadelphia • Tulsa • Fort Worth • Houston • New York

PACIFIC COAST—The California Wire Cloth Corporation, Oakland 6, California

Associations

API President Named to Serve On Honorary Steel Committee

William R. Boyd Jr., president of American Petroleum Institute, together with seven presidents of other National Associations in the alloy steel consuming and producing fields, and the presidents of the three largest steel producing companies, have accepted appointments from the American Society for Metals to serve with the society's president and vice president, Francis B. Foley and Harold K. Work, on the honorary committee covering the "Salute to Alloy Steel," central theme of the National Metal Congress and Exposition, which holds its 30th annual convention in Philadelphia, Oct. 25-29.

Other association presidents on the honorary committee are Oliver P. Echols, Aircraft Industries Association of America; George W. Mason, Automobile Manufacturers Association; William C. Johnson, NEMA; J. H. Oppenheim, Farm Equipment Institute; A. G. Bryant, National Machine Tool Builders Association; William T. Faricy, Association of American Railroads; and Walter S. Tower, American Iron and Steel Institute.

Serving for the three major alloy steel producers are their presidents: Benjamin F. Fairless, U. S. Steel; A. B. Homer, Bethlehem Steel Company, and C. M. White of Republic Steel Company.

Postage Stamp Honoring Oil Industry May Be Issued in 1949

The Post Office Department has promised to give "every possible consideration" to issuance of a special postage stamp on August 27, 1949, commemorating the 90th anniversary of completion of the Drake Well in Titusville, Penn. Colonel Drake's successful well marked the beginning of the oil industry.

Rep. L. H. Gavin (R-Pa.) of Oil City recently announced that he intends to introduce a bill in the next session of Congress providing for issuance of the stamp.

Ohio Oil and Gas Association Elects J. A. Upham President

James A. Upham, Mt. Vernon, has been re-elected president of the Ohio Oil and Gas Association and John E. Morrow, Pittsburgh, has been elected vice president and chairman of the executive committee.

Members of the executive committee are Marshall B. Belden, Canton; John E. Bird, Hanley & Bird, Wooster; C. T. Bole, Quaker State Oil Refining Corporation, Marietta; Rolland Cox, Cox Drilling Corporation, Wooster; Peter B. Lilly, National Gas & Oil Corporation, Newark; and Kenneth P. Milliken, Waverly Oil Works Company, Lancaster.

Fogle & Fogle, attorneys of Marietta, were retained as legal counsel for the organization and Philip N. Faine, Logan, continues as executive secretary. The association, which was formed a year ago effecting a merger of two former Ohio oil and gas groups, maintains offices at Newark.

THOMPSON-HAYWARD
FORMALDEHYDE
for corrosion control

You can protect your casings, rods, and all exposed metal parts for only a few cents a day. You can

- SAVE ON PULLING COSTS
- SAVE ON NEW STEEL
- SAVE ON SHUTDOWN TIME

Thompson-Hayward Formaldehyde gives dependable protection from hydrogen sulphide corrosion and corrosive mine and well waters.

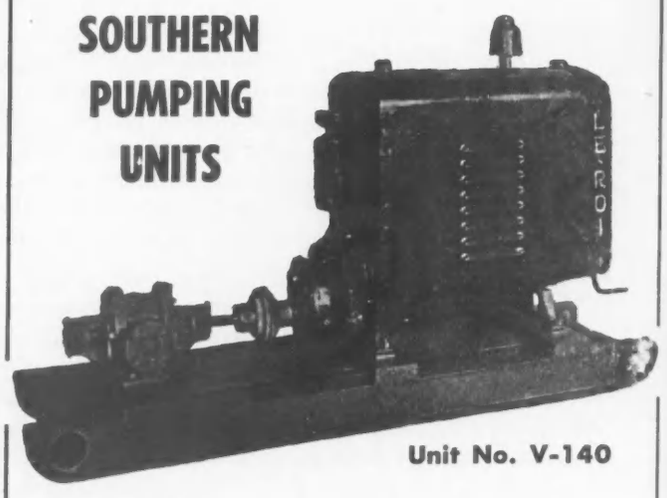
Write our nearest office for detailed information

THOMPSON-HAYWARD CHEMICAL CO.

Dallas Houston Denver
Wichita Tulsa San Antonio
New Orleans

(B)

SOUTHERN PUMPING UNITS



Unit No. V-140

Le Roi Power Unit — Viking Pump Capacity 140 barrels per hour.

Complete units and replacements in Houston and Kilgore stocks.

SOUTHERN ENGINE & PUMP COMPANY

MANUFACTURERS • MACHINERY FACTORS • CONTRACTORS
Houston - Dallas - Kilgore - San Antonio - Edinburg

Another Great Truck in a Great Line

THE NEW FWD MODEL·YU

Four-Wheel-Drive Truck

It's the New Leader in its Class

FWD continues to offer the most advanced features available in a modern heavy duty four-wheel-drive truck — with the new model YU:

*ENGINE: Full 142 H.P., overhead valve, wet-sleeve type, counterbalanced crankshaft.

*TRANSMISSION: 5 speed with helical gears in constant mesh *in all speeds;* extremely wide range from direct to 9.95:1 in low.

*SILENT CHAIN TRANSFER: FWD proven type; enclosed and operating in oil bath.

*NEW CENTER DIFFERENTIAL LOCK: Vacuum controlled with tell-tale warning light; touch-button locking and unlocking.

*NEW AXLES: Front and rear, of FWD's proven single reduction design. Large spiral bevel ring gears and pinions; axle design tested and proved in actual service.

*STURDY 8-SPOKE WHEELS: with locked rims to take the torque.

*HIGH TORQUE HYDRAULIC BRAKES: Hydrovac-operated with full floating shoes, double wheel cylinders, ample braking power for truck and load under all conditions.

*GIRDER TYPE FRAME: designed for rugged strength plus ease of equipment mounting. Center pivoting radiator mount to eliminate core stresses.

*ALL STEEL TURRET TYPE SAFETY CAB: Designed for operator comfort. 30% greater visibility. Centrally grouped controls and instruments. Adjustable seats — large glove compartment. Air conditioning optional.

*NEW CROWN-TYPE FENDERS WITH INTEGRATED SKIRTING: Designed for convenient, easy access to engine. Skirting removable in one piece for easy installation of front mounted equipment. 3 piece hood with readily removable, hinged side panels.

America's Foremost Heavy Duty Truck

See your nearest FWD distributor or write for complete information.

THE FOUR WHEEL DRIVE AUTO COMPANY

CLINTONVILLE, WISCONSIN

Canadian Factory: KITCHENER, ONT.

Oilwell Drilling Contractors Make $10,000 Educational Grant

The American Association of Oilwell Drilling Contractors has made a grant of $10,000 to the University of Texas. According to W. F. Jones, secretary of the California chapter of the association, the funds will be used to further the educational program of the association for 1948-49. Plans call for courses in drilling practice, cost accounting, drilling mud control, mechanical training, supervisory training, etc.

In addition to daytime classes for regular students of the school systems, extension courses are to be given for men now employed in the oil business. Many of these subjects are now available in the Mid-Continent. In California courses in drilling mud control will be resumed in September at Long Beach and at Bakersfield. On the same date a two-year course in drilling practice will be begun at Long Beach Junior College.

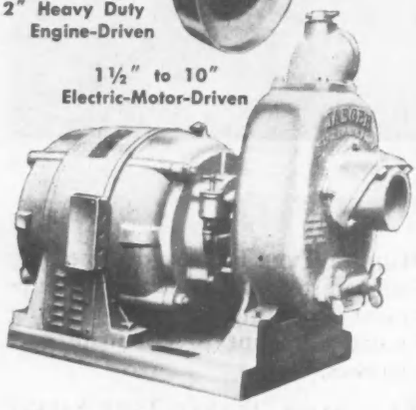
another reason why

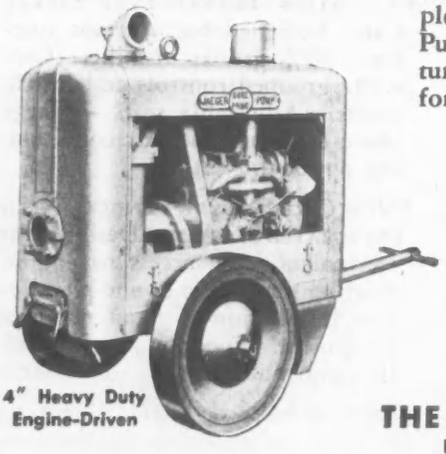
JAEGER PUMPS are the kind you need...

low-cost pumping!

2" Heavy Duty Engine-Driven

1½" to 10" Electric-Motor-Driven





4" Heavy Duty Engine-Driven

There's not a pound of excess weight in Jaeger "Sure-Prime" Pumps—you get all pump for your money. Yet, they're rugged and designed for greatest pumping service per operating dollar. One example — Jaeger patented priming-jet cut-off, which stops priming circulation once prime is established, adds 8 to 12 per cent to operating efficiency. Another — Jaeger "Lubri-Seal" that positively prevents air or fluid losses along the pump shaft — maintains that seal for long periods. And there are hardened-steel liner plates, trouble-free trash-type impellers, extra and massive center support bearing for shafts of all pumps from 4" up. These and other Jaeger features add up to top efficiency and low maintenance. Catalog PF8 shows the complete line of Jaeger "Sure-Prime" Pumps and explains their many features for low cost pumping. Write for it!

APPLICATIONS
Drill Rig Water Supply • Tank Transfer
Jetting • Dewatering Pipe Lines
Mud Transfer • Pumping Tank Bottoms
General Dewatering

SIZES
1½ to 10 inches • 3,000 to 240,000 gph

TYPES
Engine and Motor-Driven
Lightweight • Heavy Duty • Jetting
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Long Beach Junior College To Offer Course in Drilling

A two-year course in oil well drilling practice will be inaugurated at Long Beach, Calif., Junior College this fall. The course is being sponsored by the American Association of Oilwell Drilling Contractors with the cooperation of H. W. Ferguson, coordinator of Trades and Industries, and J. E. Hollingsworth, dean of the Division of Business and Technology of the Junior College.

Fort Worth Geophysicists Elect Sidon Harris President

Dr. Sidon Harris, president of the Southern Geophysical Company, Fort Worth, has recently been elected president of the Fort Worth Geophysical Society. Dr. Harris received his Ph.D. degree in physics from the University of Texas in 1934. Prior to organizing the Southern Geophysical Company in 1945, he served in the Geophysical department of Stanolind Oil and Gas Company for ten years.

Dr. Sidon Harris

Winfield Elected President Of North Texas Oil Scouts

J. W. Winfield, scout for American Republics Corporation in North Texas has been elected president of the North Texas Oil Scouts Association, with headquarters at Wichita Falls, Texas. Other officers include Gregg Morris, Standard Oil Company of Texas, first vice-president; William M. Kay, Magnolia Petroleum Company, second vice-president; W. M. Ayers, Cities Service Oil Company, secretary-treasurer; Phil E. Miller, Gulf Oil Corporation, editor.

Dr. Gustav Egloff To Speak At Annual Meeting of IPAA

Gustav Egloff, director of research for the Universal Oil Products company for more than a quarter of a century, will be one of the featured speakers at the annual meeting of The Independent Petroleum Association of America to be held in San Antonio on September 27 and 28. The subject of Professor Egloff's talk will be "Can the United States Be Self-contained As To Oil."

Professor Egloff is the holder of more than 250 patents here and abroad on oil processing and the author of more than 300 technical articles and "Earth Oil," the outstanding interpretation of oil from the layman's viewpoint.

He has been awarded 22 honorary degrees, fellowships and awards. A member of 17 technical societies, in which he has served as an officer, and is a member of 17 other clubs and organizations.

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Interstate Compact Commission To Survey Stripper Well Areas

Survey of the nation's stripper well areas to determine the quantity of oil that may be recovered by both primary and secondary production methods now is being made by the Interstate Oil Compact Commission in cooperation with the Independent Petroleum Association of America and the National Stripper Well Association.

State agencies and consultants now are working in practically every state and it is expected that results of the study may be available late in 1948. When completed the survey will provide up-to-date data on the number of producing and abandoned wells, productive acreage, production and reserves of every area in the nation. In most instances the information will be by fields.

American Petroleum Institute Appoints Four New Directors

Four changes on its board of directors have been announced by the American Petroleum Institute. New directors are L. F. McCollum, president, Continental Oil Company, Ponca City, Okla., vice the late D. J. Moran of the same company; J. H. Peper, Northern Pipeline Company, New York, vice D. S. Bushnell, of the same company, resigned; A. W. Ambrose, Cities Service Oil Company, Bartlesville, Okla., vice H. R. Straight, Bartlesville, resigned; and Burl S. Watson, Petroleum Advisers, Inc., New York, vice Harry D. Frueauff, of the same organization, resigned.

McCollum also was elected to the executive committee in place of W. S. Ferguson, resigned.

Santa Fe To Run Special Train To API Convention at Chicago

One of the finest special trains ever to leave the state will transport Texans to the API convention at Chicago November 8-11, it was declared by P. H. Swinney, Houston division passenger agent of the Santa Fe, in announcing schedules.

A streamlined, diesel-powered train will leave Houston at 3 p.m., Saturday, November 6, and arrive at Dearborn Station, Chicago, at the same time the following day. Because there is no major football game in Houston, a schedule has been worked out for those desiring to attend the S.M.U.-Texas A. and M. game at Dallas November 6. Swinney said that round trip tickets purchased in Houston will be honored over the Burlington Rock Island train which will leave Houston at 9 a.m. and arrive in Dallas at 1:05 p.m. After the game, a bus or other transportation may be used to Fort Worth. The special from Houston will reach Fort Worth at 8:50 p.m. and leave ten minutes later.

On the return trip, the train will leave Dearborn Station at 3 p.m. Thursday, November 11, arrive in Fort Worth at 9 a.m., leave ten minutes later, and arrive in Houston at 3 p.m.

Those for whom the going or returning schedule of the special is not convenient may use the 25-hour streamliner "Texas Chief" in one direction and the special in the other, Swinney pointed out. The "Texas Chief" will leave Houston at 8 a.m. and arrive at Chicago at 9 a.m. the following day. Southbound, the train will leave Chicago at 6 p.m. and arrive in Houston at 7 p.m. the following day.

All space on the special train except uppers and lowers has been reserved, but additional cars are on order and those desiring accommodations should write Swinney at 800 Travis Street or telephone Fairfax 7321. If the desired space is not available, listings will be made in the order in which they are received and then assigned upon cancellations or the receipt of additional cars. Before requesting Pullman space, check with your traffic manager, Swinney advised.

The special will carry the latest type of club, lounge, and observation cars with all room and section-type Pullman cars.

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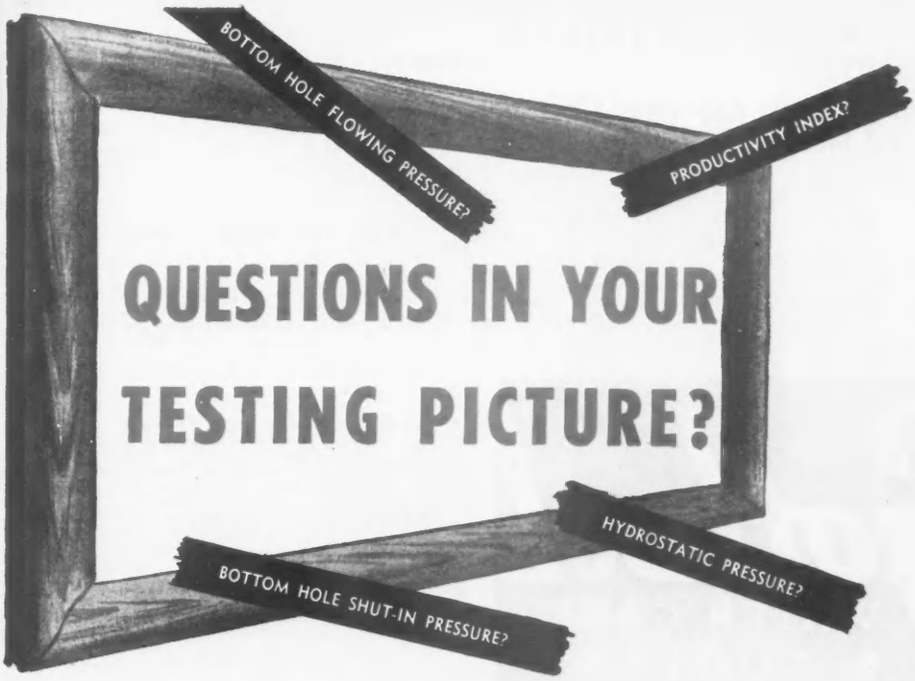

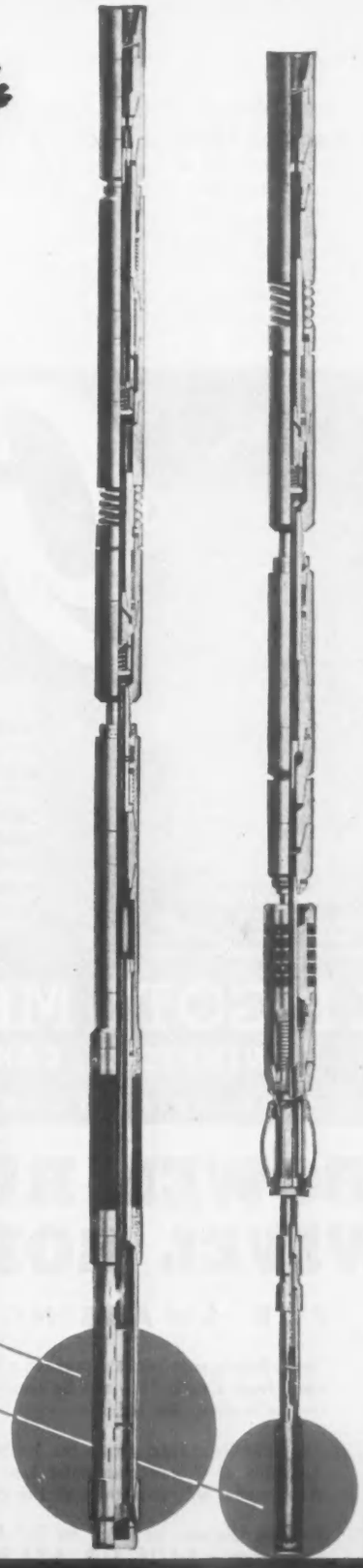

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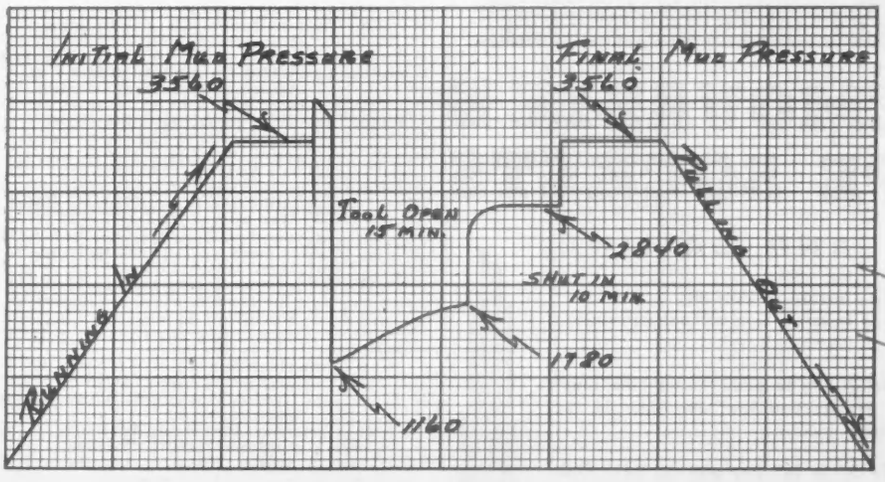

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350 Attend Annual Whing Ding Of Los Angeles Nomad Chapter

Approximately 350 members and guests attended the annual Whing Ding party of the Los Angeles Chapter of Nomads held at Long Beach July 16 at the Lakewood Country Club. Golf and other games of chance and skill were played. Presentation of door and other prizes was followed by dinner and floor show.

J. R. Lewis Appointed Chairman Of National Petroleum Board

James R. Lewis, Deming, N. Mex., has been appointed chairman of the National Petroleum Board, succeeding Ray O. Armstrong, who has resigned because of ill health. Lewis has been a member of the board's oil inspection staff since 1933 and a member of the board since 1946.

Jack Peterson, Covington, Tenn., has been appointed a member of the board. Peterson has been examiner in charge of the Kilgore, Texas, office. Selman J. Jones, Tyler, Texas, a member of the staff since 1934, has been appointed alternate member of the board.

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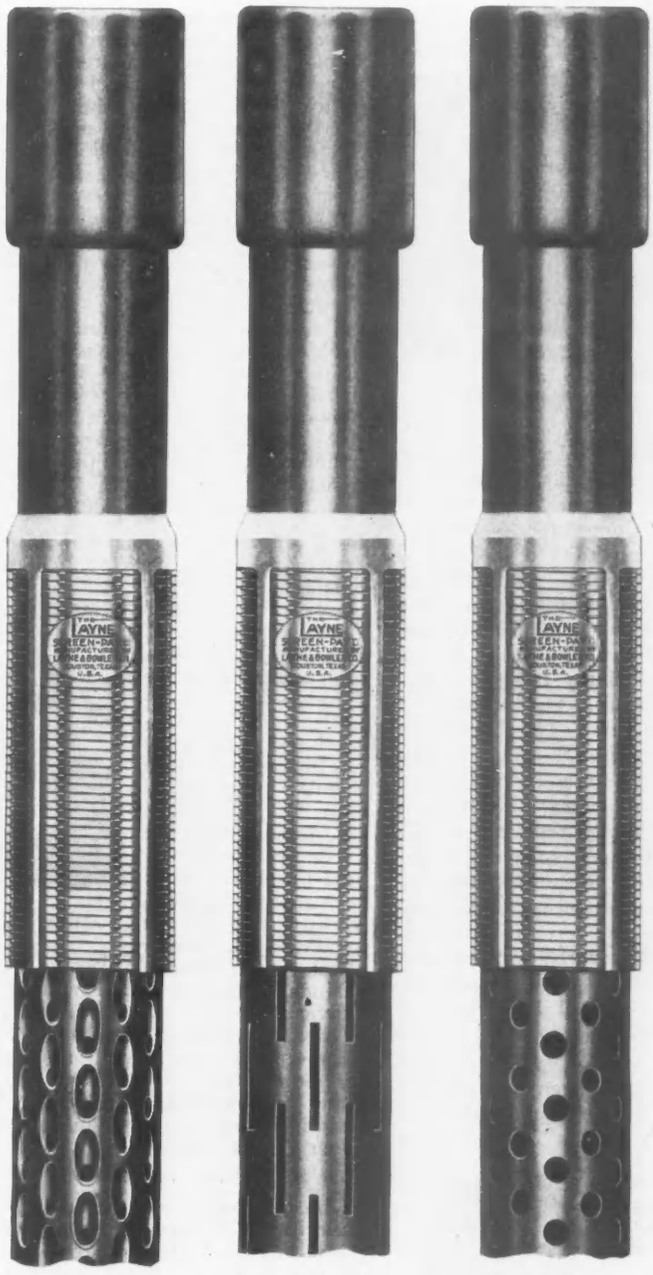
Solid Liner Type

THE OIL MAN'S CALENDAR

SEPT.	
1– 2	Oil Industry Information Committee, Minneapolis, Minn.
7– 8	American Bar Association, Section of Mineral Law, Seattle, Wash., Olympic Hotel.
7– 9	American Society of Mechanical Engineers, Fall Meeting, Portland, Ore., Reed College.
12–14	Southwest LP-Gas Convention and Trade Show, Oklahoma City, Skirvin Hotel.
14–16	Pacific Coast Gas Association, Annual Convention, Santa Cruz, Calif., Hotel Casa del Rey.
15–17	American Petroleum Institute, Lubrication Committee, Hotel Traymore, Atlantic City, N. J.
15–17	National Petroleum Association, Hotel Traymore, Atlantic City, N. J.
16–18	National Petroleum Association, Atlantic City, N. J., Hotel Traymore.
27–28	Indpendent Petroleum Association of America, Annual Meeting, San Antonio, Plaza Hotel.
OCT.	
3– 6	American Society of Mechanical Engineers, Petroleum Division, Amarillo, Texas, Herring Hotel.
4– 6	American Institute of Mining & Metallurgical Engineers, Petroleum Division, Fall Meeting, Dallas, Adolphus Hotel.
4– 9	American Association of Petroleum Geologists, Midyear Meeting, Pittsburgh, Pa.
4– 9	American Gas Association, Annual Convention, Technical Section, Atlantic City, Ambassador Hotel.
5– 6	Oil Industry Information Committee, New York.
8	California Natural Gasoline Association, Annual Fall Meeting, Ambassador Hotel, Los Angeles.
11–13	American Association of Oilwell Drilling Contractors, Annual Meeting, Houston, Rice Hotel.
13–14	South Dakota Independent Oil Men's Association, Huron, S. Dak., Marvin Hughitt Hotel.
14–15	Indiana Independent Petroleum Association, Fall Convention, Indianapolis, Ind., Hotel Severin.
14–15	Texas Mid-Continent Oil and Gas Association, Annual Meeting, Fort Worth.
14–15	American Institute of Mining & Metallurgical Engineers, Petroleum Division, Fall Meeting, Los Angeles, Elks' Club.
24–26	Tennessee Oil Men's Association, Fall Convention, Peabody Hotel, Memphis.
26	Independent Natural Gas Association of America, Annual Meeting, Mayo Hotel, Tulsa.
29–31	West Texas Geological Society, Field Conference, Big Bend Region of Southwest Texas.
NOV.	
3– 4	American Society of Mechanical Engineers, Fuels Division, Green Brier Hotel, White Sulphur Springs, W. Va.
8–11	American Petroleum Institute, Annual Meeting, Chicago, Stevens Hotel.
MAR., 1949	
24–25	New England Gas Association, Boston, Hotel Statler.
APRIL, 1949	
13–15	National Petroleum Association, Hotel Traymore, Atlantic City, N. J.

Nomads Chapter monthly meetings: **Los Angeles**, second Wednesday, Jonathan Club. B. M. Landis, Secretary. **Houston**, second Monday, Houston Club, Harry E. Estes, Secretary, Telephone Charter 4-7611. **Dallas**, L. A. Little, Secretary, Telephone Justin 8-1726. **Tulsa**, third Wednesday, Hotel Tulsa, Anthony Gibbon, Secretary, Telephone 3-1844. **New York**, first Monday, Louis Sherry's, Norris Boulden, Secretary, Telephone WIcersham 2-1311, extension 260.



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Men in the Industry NEWS

K. E. Beall has been elected vice president, Economics department of Phillips Petroleum Company. Beall succeeds **J. M. Sands,** who reached retirement age this year. Beall joined Phillips in 1920 as a production engineer. Upon the organization of the Economics department he transferred to that department and since 1946 he has served as manager.

K. E. Beall

W. J. Murray, Jr., member of the Railroad Commission of Texas, has been appointed chairman of the Texas Petroleum Research Committee, sponsored jointly by The University of Texas and Texas A&M to increase production of Texas petroleum. Committee members are **Harold Vance** and **Albert B. Stevens,** Department of Petroleum Engineering, Texas A&M, and **Harry H. Power** and **George H. Fancher,** Department of Petroleum Engineering, The University of Texas. The committee is to develop a program of research in petroleum engineering with particular emphasis on problems of secondary recovery of oil, improvement of primary recovery methods, and any other means seeking to increase the total quantity of oil recovered and to be recovered from Texas oil fields. Several research projects are now being carried out and suggestions for additional study will be welcomed by the committee.

Charles E. Spahr has been elected vice president of the Sohio Pipe Line Company, a subsidiary of The Standard Oil Company (Ohio). Spahr has been general assistant to **S. H. Elliott,** vice president of the parent company in charge of transportation. He has been with Sohio since 1939 except for a period of service during World War II and has worked in an engineering capacity on various transportation projects. In November of 1945 he was named industrial relations assistant in the transportation department of Sohio. Prior to his Sohio employment, Spahr had been associated with Phillips Petroleum Company as assistant to the vice president of the engineering department.

Charles E. Spahr

Steve Lenich has joined the Scouting department of Central Pipe Line Company, Salem, Ill.

Max Barash, chief counsel of the U. S. Geological Survey, has resigned to enter the private practice of law in Washington. Barash entered the department's legal service in 1933 as senior attorney in the Bureau of Land Management. Since November, 1943, he has been chief counsel of the survey. Regarded as one of the foremost legal authorities on the development and leasing of the mineral resources on the public domain, Barash, during the past 15 years, has participated in drafting most of the major legislation pertaining to these problems. The development and operation of oil and gas fields and the discovery of new oil reserves on the public domain under unit and cooperative agreements have received added stimulus under the simplified regulations which he helped draft.

R. S. Homet has been appointed general manager of the Foreign Trade department of the Socony-Vacuum Oil Company, Inc. **F. E. Powell, Jr.** continues as chairman of the Foreign Trade Committee of Socony-Vacuum. **J. J. Pettey** has been named a member of the Foreign Trade Committee, taking over the position previously held by Homet, with responsibility for the company's operations in Portugal, Spain, West Africa, Spanish Morocco, Canary Islands, Gibraltar and Tangiers, **Philip Clover** has been recalled from Europe to become a member of the Foreign Trade Committee, with responsibility for South and Central America, Germany and Austria. **J. S. Vesey Brown** has been appointed manager of the West Africa Division.

R. S. Homet

A. A. Corona, vice president of Pan American Petroleum & Transport Company, has been elected director of Pan American Production Company. **P. J. Sweeny,** first vice president of Pan American Refining Corporation, has been been elected director of Pan American Gas Company. **L. W. Moor,** general manager of manufacturing, Pan American Refining Corporation, has been elected director of Pan American Pipe Line Company. **Harold Decker,** vice president and director of Pan American Production Company and Pan American Gas Company, has been elected member of the executive committee for both companies. **R. H. Maupin,** director of Pan American Pipe Line Company, has been elected member of the executive committee.

E. LeRoy Young has been named secretary of The Carter Oil Company. He studied at Kansas Wesleyan University at Salina, Kansas, and has been associated with Carter for the past 14 years.

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Stanley A. Wilson, Arizona division manager for the General Petroleum Corporation, has retired, and **Paul R. Nilsson,** former assistant division manager, has been named to succeed him. Wilson, who joined General Petroleum in 1935 as a wholesale salesman at Salt Lake City, has been identified with the Arizona offices since 1938, having served there as district manager, district sales manager, and division manager. During the war he was a member of the PAW industry committee for Arizona. Nilsson joined the company in 1923 in the company's engineering department at the Vernon, Calif., plant. Before going to Arizona as manager of the Phoenix Branch in 1944, he filled various positions in the San Diego, Los Angeles, and Bakersfield offices.

»

Simon J. Vos, manager of Regent Oil Company, Ltd. and acting managing director of Trinidad Leaseholds Limited, both of London, has been appointed a director of Central Mining & Investment Corporation of London.

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George B. Jenkinson, Jr., formerly in charge of the Land department for Stanolind Oil and Gas Company at Tulsa, has been named assistant manager of foreign exploration and is succeeded by **William G. Lackey.** Jenkinson will work with **C. T. Jones,** manager of foreign exploration. Jenkinson went to work for Midwest Refining Company in the Producing department and held a number of posts in the department until 1924 when he organized Midwest's Land department in Denver, Colo. He joined Stanolind when that company absorbed Midwest and has been Land department manager since 1941. Lackey started with Stanolind as a landman in 1935. He had the positions of district landman at Wichita, Kansas and division landman at Fort Worth and Houston before becoming assistant leasing supervisor.

»

A. W. Tarkington of Tulsa, formerly assistant treasurer of Bethlehem Supply Company, has been appointed treasurer of the Continental Oil Company, succeeding **S. B. Jurenev,** who was elected to serve on a temporary basis last May. Tarkington's first job was with the First National Bank of Dallas. He joined Bethlehem Supply Company in 1937. Jurenev has been appointed manager of Continental's Coordinating and Planning department, which is being created to coordinate activities and to develop financial plans and programs. He will also continue as secretary of the company.

A. W. Tarkington

»

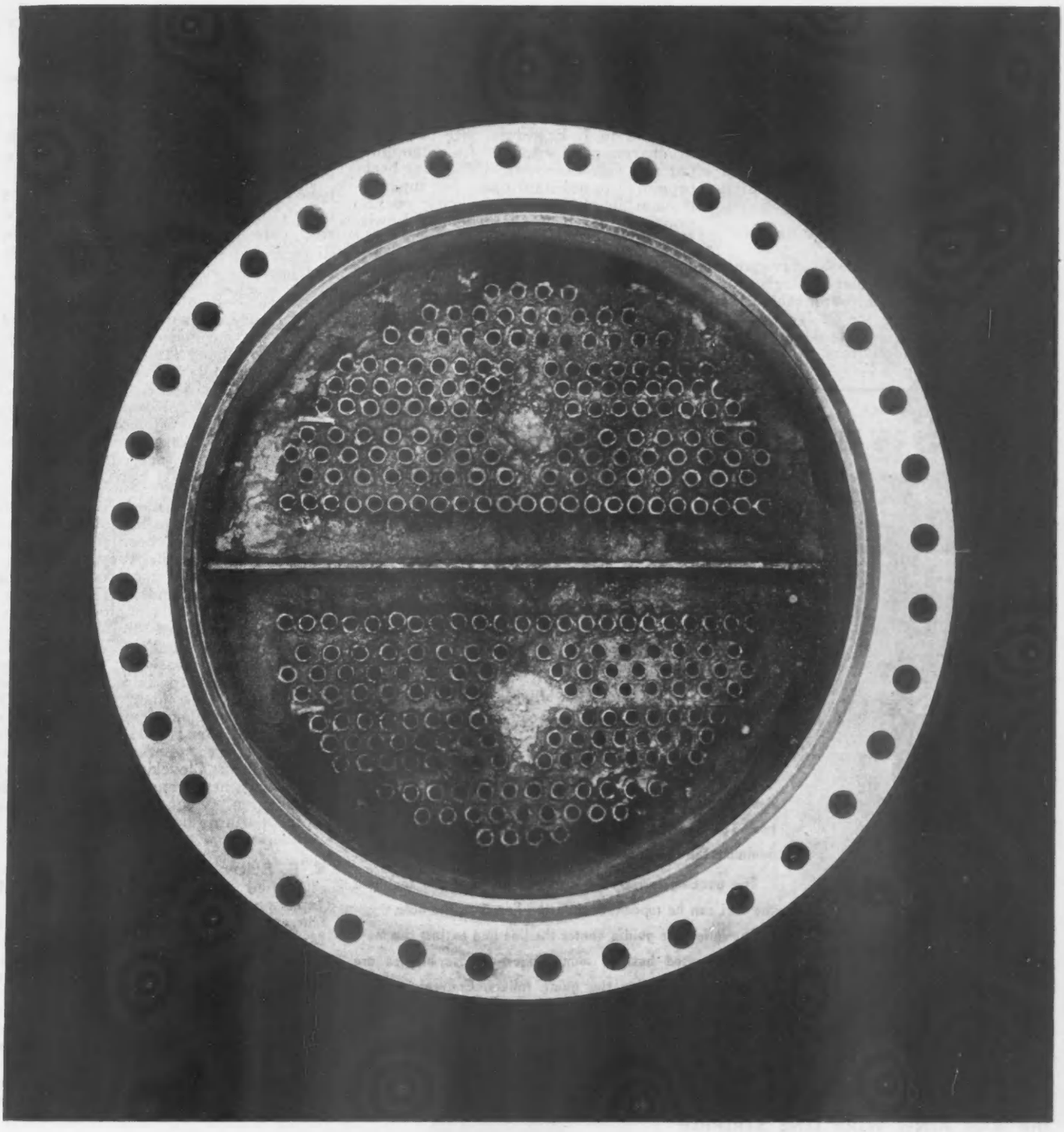
J. H. Snyder has been appointed director of market research for Contintental Oil Company at Ponca City, Okla. Formerly with several internationally known manufacturers and merchandisers in the automotive and aviation fields, he has had a varied background of experience in all phases of marketing, advertising, sales promotion, and market research. During the past three years Snyder has been in Cleveland as director of market research for a large manufacturing concern and vice-president of a smaller company in that city.

»

N. C. Draper, formerly assistant purchasing-stores representative for Shell Oil Company's Tulsa area, has been assigned to the regional purchasing-stores department in Houston. In his new capacity, Draper will have the responsibility of handling pipe requirements, the coordination of surplus material among the company's areas, and general phases of production purchasing-stores activities.

»

Tom Duncan, LaSalle, Ill., has joined N. V. Duncan, Inc., drilling contractors-producers, at Fairfield, Ill.



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E. A. Slade, construction superintendent, and **J. C. Stirling**, authorization supervisor, have been apointed members of the Operating Conference of Stanolind Pipe Line Company. The Operating Conference is a special advisory group to the Board of Directors.

»

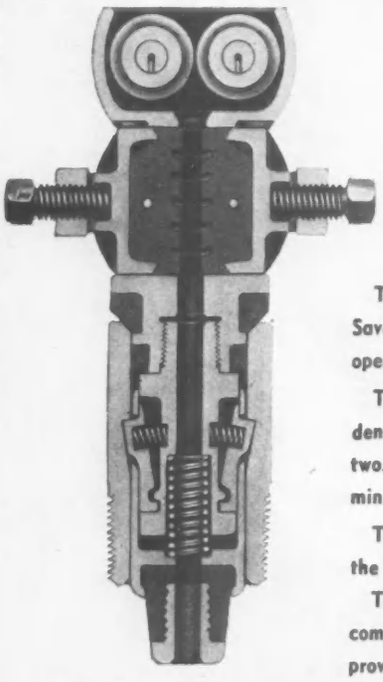
Dr. Theodore A. Link has resigned from his position as chief geologist for Imperial Oil Limited, with which he has been associated for 29 years. Dr. Link will engage in general consulting practice, with headquarters in Toronto.

W. M. Montgomery, formerly executive assistant to J. E. Rouse, vice president in charge of operations for Stanolind Oil and Gas Company, Tulsa, has been promoted to assistant operating superintendent in charge of producing operations and has been succeeded by **Lewis Finch, Jr.**, formerly West Texas district superintendent at Midland, Texas.

»

Paul J. Moore has resigned as district engineer for the Gulf Oil Corporation and has opened an office as petroleum consultant in San Antonio.

For Swabbing Operations



Be Sure IT'S A KING *Be Safe*

TYPE 3AR AUTOMATIC RELEASE WIRE LINE STRIPPER

Type 3AR King Wire Line Stripper (often called "Oil Saver") is the ideal tool to use in connection with swabbing operations.

The positive latch and sure release insure against accidents and eliminate the possibility of jerking a wire line in two. The non-sparking materials used in its construction, minimize the fire hazard.

The packing is inserted from the sides of the tool and the tool can be repacked while the line is in the hole.

The roller line guides center the line and outlast the more commonly used bushing many times. Grease nipples are provided to lubricate the guide rollers. Convenient hand holds contribute to easy handling of the tool. *This tool is constantly coming into greater use.* A trial is convincing.

FOR WIRE LINE CORING
the 4AR KING WIRE LINE STRIPPER is widely used

The Type 4AR Stripper is similar to the Type 3AR, except it is a little larger. It is commonly used in connection with the Type 4C King Circulating Head. It can be, and sometimes is used with other makes of circulating heads.

All prices F.O.B. Houston, Texas, and subject to change without notice.

Sold through your supply store
Export: R. S. STOKVIS & SONS, Inc.
17 Battery Place, New York 4, N. Y.
See 1948 Composite Catalog (Pages 2129 to 2140) for detailed description of other King Tools.

KING OIL TOOLS
210 TERMINAL STREET PHONE W. 6-8013
HOUSTON 10, TEXAS

D. C. Rhodes has been appointed district superintendent of Humble Oil & Refining Company's new district office in Freeport, Texas, which was established to supervise marine operations off the Texas Coast. **E. E. Byrd** is district petroleum engineer; **D. J. Lewis**, district civil engineer; and **R. L. Smith**, district chief clerk.

»

L. A. Henry, sales manager, airports and airlines, in the general office of Standard Oil Company (Indiana), at Chicago, has been promoted to assistant manager-reseller at Decatur, Ill. **R. E. Lee**, assistant manager at Decatur, has become assistant manager-wholesale there. **R. D. Sharp**, sales manager-reseller in the Chicago division, succeeds Henry.

»

T. B. Campbell, formerly division engineer at Houston for Stanolind Oil and Gas Company, has been made district superintendent of the West Texas district at Midland, succeeding **Lewis Finch, Jr. E. L. Hinds**, core drill supervisor with a Florida exploration party, has been promoted to division core drill supervisor at Fort Worth. **L. R. Turner**, formerly assistant field clerk has been promoted to field clerk for the North Cowden area, Odessa. **J. D. Christner**, petroleum engineer, has been transferred from Lubbock, Texas, to the Levelland area, Levelland, Texas, as field engineer. **Cleveland M. Bratton** and **Roy Coats**, head roustabouts in the East Texas area, Greggton, have been promoted to farm bosses.

»

R. S. Blazer has been named president of Allied Oil Company, Inc.; **L. M. Jonassen** has been named president of Cleveland Tankers, Inc.; and **C. H. Marshall** has been named president of Central Pipe Line Company. The three companies will operate as independent subsidiaries of the newly expanded Ashland Oil & Refining Company. Former owners and heads of these companies, **F. R. Newman** and **W. W. Vandeveer**, will no longer be identified with the operating management, according to the terms of the merger of Allied Oil and Ashland Oil & Refining Company.

»

R. L. Tollett was elected president of Cosden Petroleum Corporation at a recent meeting of the board of directors, **Marvin M. Miller** and **Douglas L. Orme** were elected vice presidents; **A. V. Karcher**, secretary and treasurer; **V. A. Whittington**, assistant secretary and assistant treasurer; and **Nelson Phillips, Jr.**, assistant secretary and general counsel.

»

J. B. Aug. Kessler, having reached retiring age, has resigned as a managing director of the Royal Dutch-Shell group of oil companies. He will continue to act as general managing director of the Royal Dutch Company and will remain on the board of the Bataafsche Petroleum Maatschappij, Anglo-Saxon Petroleum Company, and Shell Petroleum Company.

3 YEARS AGO WE SAID...

"Mounts made of Du Pont neoprene (on the Schlumberger Dipmeter) are used because they deaden shock and resist terrific abrasion caused by sliding contact with thousands of feet of various formations . . . because they resist oil, gas, acids and salt water encountered in the well. And neoprene is long-lived. It minimizes replacements, helps keep maintenance costs at a minimum."

THAT'S STILL TRUE TODAY...

and has been since 1937!

HERE'S THE PROOF... The neoprene on the old Dipmeter shown here has seen years of *grueling* service. Uncounted times it has been dropped down and yanked up out of jagged drill holes . . . at speeds of 15,000 to 20,000 feet per hour. Repeatedly, this neoprene has been tortured with bottom-hole temperatures as high as 300° F., heat that would vulcanize ordinary rubber. And "down under" 12,000 to 15,000 feet, this neoprene has been crushed by pressures as high as 6,000 p.s.i.

The neoprene on these electrodes has been dragged through rough drill holes a distance totaling well over a million feet. And now this old Dipmeter (photo to the right) has been retired from long, faithful service. It's badly bruised . . . as you can see from the photo . . . *but it's still far from "dead"!*

Since 1937, engineers of the Schlumberger Well Surveying Corporation, world's largest electrical well logging service, have been using Du Pont neoprene on their instruments. Operating in oil fields over the entire globe, with over 500 surveying equipment trucks and engineering crews, they have tested neoprene as no laboratory could ever hope to.

Neoprene serves them best because its resiliency suffers no deterioration while it is out of service between jobs . . . because it provides efficient electrical insulation . . . because there's nothing in the oil, gas, acids, salt water, high temperatures, high pressures or terrific abrasion that rough oil field service can dish out *which neoprene can't* take!

For information on how neoprene can serve *you*, write us today about *your* specific problem — there's no *obligation!* E. I. du Pont de Nemours & Co. (Inc.), Rubber Chemicals Division K-9, Wilmington 98, Delaware.

FREE! The Neoprene Notebook. *Interesting stories . . . new, unusual applications of neoprene. Write . . . E. I. du Pont de Nemours & Co. (Inc.), Rubber Chemicals Division K-9, Wilmington 98, Delaware.*

HERE'S WHY NEOPRENE DOES SO MANY JOBS SO WELL!

- ★ High tensile strength, resilience, low permanent distortion.
- ★ Tough and durable, resists abrasion and cutting.
- ★ Superior resistance to sunlight, aging, ozone, and heat.
- ★ Resistance to deterioration by oils, solvents, chemicals, acids.
- ★ Superior air-retention, low permeability to gases and fluids.
- ★ Special compositions are flame-retarding, static-conducting, flexible at low temperatures.

DU PONT

REG. U.S. PAT. OFF.

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FOR BETTER EQUIPMENT, SPECIFY

NEOPRENE

The rubber made by Du Pont

SAVE WEAR
ON TUBING AND CASING
WITH Guiberson
TUBING ANCHOR

Tubing won't breathe when the type "AC" anchor holds the tubing string. String cannot be dropped as it is anchored in the hole. Makes pumping smoother and saves tubing joints. Has full area slips with large bypass for fluid and gas. It's ideal for anchoring Guiberson "GW" 2-cup packer—for supporting casing pumps—for all bottom hole tools. Made for 4¾" to 9" casing.

Type "AC" Tubing Anchor

REG. U. S. PAT. OFF.

For complete data, see the Composite Catalog Page 1533, or write to

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Guiberson U. S. A.

Established 1919

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BRANCH OFFICES: Oklahoma City and Tulsa, Okla.; Alice, Houston, Kilgore, Longview, Odessa, and Wichita Falls, Tex.; Lafayette, La.; Wichita, Kan.; Newark, Ohio.

MEN IN THE INDUSTRY NEWS

Harry B. Hill, petroleum engineer of the Bureau of Mines and supervisor of the Dallas field office for 24 years, has retired. Hill joined the Bureau of Mines in 1918 at Muskogee, Okla., and served for a time at Salt Creek, Wyo., and Washington, D. C., becoming supervising engineer in Dallas in 1924. **Charles B. Carpenter**, petroleum engineer, has been promoted to the position of supervising engineer. In addition to many petroleum engineering studies reported in Bureau of Mines publications, he has had responsible special assignments, including a number relating to petroleum supplies for war activities.

»

Dr. R. F. Faull has been appointed to the newly-created position of manager of the La Habra, Calif., oil field research laboratory of California Research Corporation, a Standard of California subsidiary. He will be responsible directly to **Earl G. Gaylord**, vice president in charge of oil field research for California Research Corporation. The company's two oil field research units, at Whittier and La Habra, are being combined into one organization under Dr. Faull's direction, with headquarters at La Habra. Assisting Dr. Faull will be **Walter C. Dayhuff**, who has been named technical assistant in charge of administrative functions and surface processing research, and **Dr. M. B. Standing**, division supervisor in charge of research on drilling and production. Dr. Faull joined Standard in 1937 in its research and development department, the predecessor to California Research Corporation. His most recent position, to which he was appointed in 1945, was that of supervisor of the refinery technology and technical service division at the Richmond laboratories of C.R.C.

Dr. R. F. Faull

»

J. G. Campbell has been named manager, Supplies and Economics division of Deep Rock Oil Corporation. Other additions to the executive staff are **A. R. Bell Jr.**, controller, and **J. H. Westbrook**, manager, Personnel and Industrial Relations division.

»

C. F. Zimmerman of Houston, Texas, has been appointed superintendent of the aviation section of the Continental Oil Company's motor transport division, with headquarters in Ponca City, Okla. For the past three years Zimmerman has been air carrier inspector for the Civil Aeronautics Administration.

»

Richard Leonard, Lacy Walker, and **Clyde Peters** have been promoted to pipe line superintendents of Midwestern Constructors, Inc., Tulsa. All have worked in the pipe line division for a number of years.

Glen H. Bowes, assistant region geologist for Continental Oil Company at Los Angeles, has resigned to become manager of the Exploration department of the Hudson's Bay Oil and Gas Company, Ltd., an affiliate of Continental Oil Company. Bowes has been with Continental Oil Company for the past 25 years as geologist and assistant region geologist in Los Angeles.

»

W. Philip Cox has resigned from the Producing department, Socony-Vacuum Oil Company, Inc., New York, and opened offices in the Shoreham Building, Washington, D. C., as a petroleum engineering and government relations consultant. Cox, a graduate petroleum engineer, has been in charge of materials operations for Socony since World War II. Prior to the war he was with the Gulf Oil organization in California and Venezuela as a petroleum engineer and superintendent of drilling and production. In 1942, he joined the staff of the Foreign Division of the PAW, where he was in charge of foreign materials programming, priorities and export license operations.

W. Philip Cox

»

Guy L. Ritchie has been promoted to division tax agent, Central division, The Texas Company, with headquarters at Lawrenceville, Ill. He succeeds **D. G. Siemer**, retired.

»

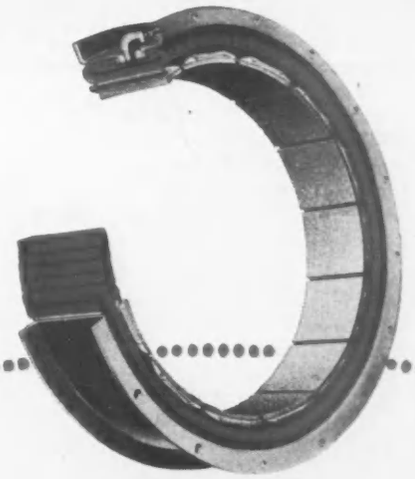
Fred B. Branson and **Allen H. Lemmon** have been elected assistant comptrollers of Gulf Oil Corporation. Branson has been assigned the supervision of production, pipe line and research accounting and auditing activities, and Lemmon will supervise general administrative accounting and continue in charge of the Statistical and Printing Standards Departments. Branson joined Gulf in 1924, later becoming assistant auditor of the Tulsa Production and Pipe Line Divisions. He was transferred to Pittsburgh as general auditor in 1940. Lemmon joined Gulf in 1920 as manager of the newly formed Statistical Department. In 1937 he was made assistant to the comptroller, in addition to his other responsibilities. A year later he was also placed in charge of the Printing Standards Department.

»

Marvin A. Crenshaw has been appointed assistant to the vice president, director of producing and manufacturing for Caltex. Crenshaw started in the oil business at the Port Arthur Refinery of the Texas Company and has since continued in manufacturing and production. He came to the New York Office of Caltex in 1938 and was manager of operations and planning until his new appointment.

SHOCK ABSORBER...

FOR MAN . . . AND MACHINE



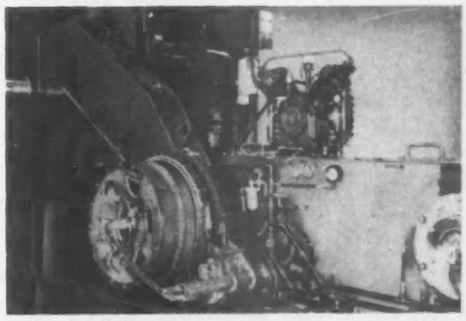
Pneumatic-tube Clutch Provides "Life Insurance" for Your Machines

Shock? Vibration? Not in modern drilling rigs equipped with Fawick Airflex Clutches!

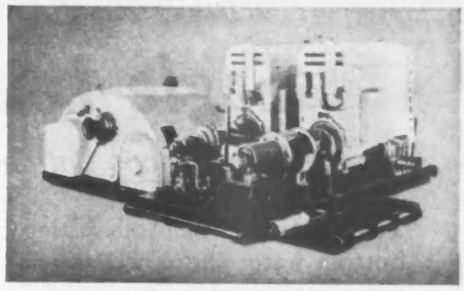
The Fawick Clutch transmits power through friction shoes carried on a rubber-and-cord tube actuated by air pressure. This flexible air cushion acts, literally, as a shock absorber and vibration cushion . . . protects the entire machine against needless wear and tear, prevents operator fatigue, gives perfect clutch control, perfect shock absorption.

Job-proved, Fawick Clutches meet the toughest operating conditions on mud pumps, engine and rotary table drives and hoist drums.

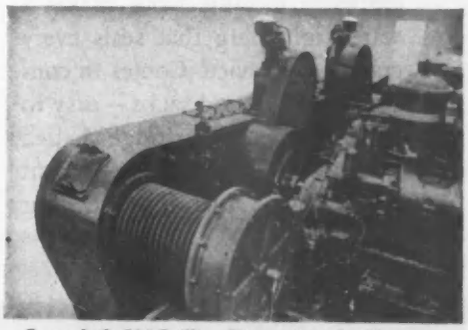
Avoid unnecessary parts replacement costs, needless down-time—always specify Fawick for your equipment.



Emsco J-1250 Drilling Rig using four Fawick Airflex Clutches.



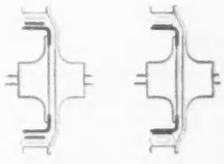
Oil Well Supply Company's No. 64A Hoist with No. 402A Dual Engine Drive equipped with three Fawick Clutches.



Emsco's G-500 Drilling Rig equipped with seven Fawick Element Assemblies on engines and mud pump.

HERE'S HOW IT WORKS

Compressed air expands the rubber-and-fabric tube to engage clutch with any degree of "grip" you want. Release the air and clutch disengages.



FAWICK *Airflex* and AIRING CLUTCH

Mid-Continent Supply Co., Ft. Worth, Texas

U. S. Oil Field Distributors and Service

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M. G. Langhorne, formerly division manager at Midland, Texas, for Phillips Petroleum Company, has been appointed manager of the company's new division office for crude oil purchases at Dallas. **John L. Hart** succeeds him.

»

Wayne Hoylman, for the past 18 years a member of the geophysical staff of the Gulf Research and Development Company, and recently in charge of Gulf's airborne magnetometer crew 15, has joined Fairchild Aerial Surveys, Inc. as their chief geophysicist.

J. B. Christian has been promoted to assistant general manager of Trinidad Leaseholds Ltd., Trinidad, B.W.I.

»

Robert O. Williams, who has been petroleum engineer at Stanolind Oil and Gas Company's Southwest District office in Corpus Christi, Texas, has been promoted to a similar position in the Houston office.

»

J. H. Singleton, former assistant chief accountant for the Shell Pipe Line Corporation in Houston, has been named chief accountant.

Benjamin Brewster has been appointed to the newly-created position of manager of the Technical Service Division of the Ethyl Corporation Research Laboratories in Detroit. He joined Ethyl Corporation more than 21 years ago as a member of the automotive engineering staff.

»

C. P. Allen, operating engineer in the manufacturing department of Stanolind Oil and Gas Company's general office in Tulsa, has been promoted to operating engineering supervisor; **Stanley G. Baker,** field clerk at Iles Dome, Loyd, Colo., to plant clerk, manufacturing department, Stanosyn plant, Garden City, Kansas; **A. J. Inderrieden, Jr.,** junior petroleum engineer, Producing department, Tulsa general office, to depreciation engineering supervisor, Economics department; **Herbert B. Langford, Jr.,** mechanical engineer, Manufacturing department, Slaughter plant, Levelland, Texas, to senior mechanical engineer.

»

T. C. Borland, formerly assistant division engineer for Stanolind Oil and Gas Company, has been promoted to division engineer at Houston. **C. M. Irving,** field clerk in the Luby area, Bishop, Texas, is the new district clerk, southwest Texas district, Corpus Christi. He is succeeded at Luby by **J. A. Sandel,** formerly assistant field clerk there. New district clerk for the Beaumont district is **G. E. Rice,** who has been field clerk for the Anse La Butte area, Lafayette, La. Replacing him at Lafayette is **H. O. Cottrell,** formerly assistant field clerk there. **W. H. Moore** is now district clerk for the south Louisiana district, Lake Charles, La. Moore has been field clerk for the Hackberry, La., area and is succeeded there by **A. E. Reseweber,** formerly assistant field clerk at Hackberry.

»

Transfers:

Donald S. McBride, petroleum engineer with Tide Water Associated Oil Company, has been transferred from Oklahoma City to Kilgore, Texas . . . **Robert O. Williams,** petroleum engineer for Stanolind Oil and Gas Company, from Southwest Texas district office in Corpus Christi to Houston division office . . . **A. T. Eyler,** division exploration engineer for Shell Oil Company, from Tulsa to Oklahoma City. **R. L. Ferris,** subsurface engineer, from El-Dorado, Kansas, to Oklahoma City. **J. M. Garlick,** subsurface engineer, from Oklahoma City to Tulsa . . . **N. H. Ratliff,** assistant district chief clerk, Humble Oil & Refining Company, from North Katy district to Friendswood district, Texas. **E. C. Clark Jr.,** district civil engineer, Lovell Lake district to Sugar Valley district, Texas. **C. J. Hopper** from Gulf Coast division office to replace Clark in the Lovell Lake district. **D. M. Griffiths,** associate civil engineer, from Maubro district to Gulf Coast division. **R. F. Wipke,** associate civil engineer, from Gulf Coast division office to Imogene district, Texas. **B. D. Strawn,** civil engineer, Gulf Coast division office, to Louisiana division.

Bottom Water is a costly profit leak

Eagle Lead Wool

***stops* Bottom Water!**

You rule out the risk of oil-wasting bottom water shutdowns when you tamp Eagle Lead Wool in the hole. This finely stranded, non-corrosive metallic wool makes a water-tight plug that seals every crack and crevice. Comes in convenient 50-pound sacks—easy to place in special cartridge-shaped Eagle Wire Containers sized to fit all casings. Order through your jobber today.

These 3 Eagle Bearing Metals meet most requirements

Eagle Dreadnaught—for extreme speed and heavy-duty conditions.

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Seals off Bottom Water—keeps 'em flowing!

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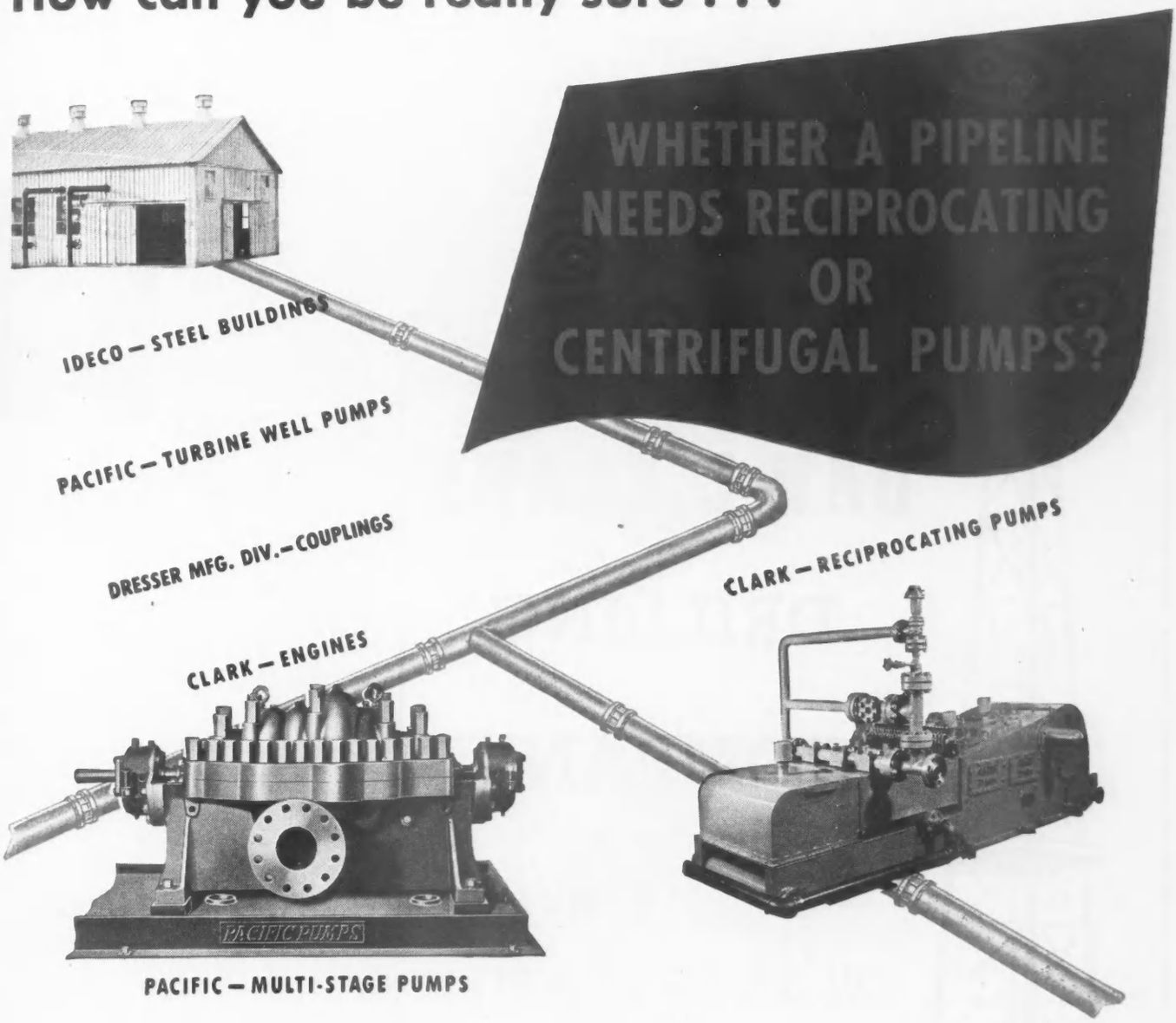
How can you be really sure . . .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Dresser Industries serves the oil industry with various types of equipment. This is the over-all policy of Dresser Industries. The operating member companies are specialists and will give you the top equipment of a specialized type—reciprocating or centrifugal, the Pacific Pumps type of Centrifugal or the Clark type.

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DEATHS

Frank Rieber, 57, died June 30 in New York City. Rieber held 48 U. S. and foreign patents and had 27 patent applications pending on inventions in the fields of geophysics, electronics, acoustics, and telemetering. Since 1940 he had been engaged in developing a new system for seismic exploration and the mapping of complex geological conditions.

»

Wesley D. Simms, 42, Tulsa, attorney for the Shell Oil Company, died August 4. He graduated from the University of Oklahoma law school and after practising law in Muskogee, Okla., moved to Tulsa 15 years ago to join Shell. He was a member of the Mid-Continent Oil and Gas Association.

Fred D. Misener, 80, Tulsa oil operator, died July 24 in Tulsa. He entered the oil industry after a career as a lumberman and is credited with a number of important discoveries in Oklahoma.

»

Hugh Bailey, accountant for Sinclair Prairie Oil Company, Tulsa, died July 23 in Tulsa. He was employed by the Prairie Oil and Gas Company in Independence, Kans, until that company merged with Sinclair in 1932.

Robert C. Tucker, 54, who retired recently as head of General Petroleum Corporation's tire, battery and accessories division, died July 17 in Los Angeles. Tucker, who had been with General Petroleum since 1939, was formerly with Firestone Rubber Company and United States Rubber Company.

»

Lee E. Barrows, 66, manager of the Texas Company's Producing department and its operations throughout the U. S. east of California from 1935 to 1947, died July 21 in Houston. Barrows, who joined the Texas Company in 1909, was made chief engineer of the Port Arthur refinery in 1913; superintendent of gasoline plants in 1919; general superintendent of the company's old North Central Texas division in 1922, and division manager in 1926. He designed three of the company's gasoline absorption plants.

Lee E. Barrows

»

George W. Strawn, Ardmore, Okla., died July 16 in Lacoh, Ill. He was a founder of the Southern Oklahoma Oil and Gas Association and took part in the Hewitt and Healdton (Okla.) field development.

»

C. W. Hamilton, 54, Tulsa, died July 30. He had been in the traffic department of the Mid-Continent Petroleum Corporation for the past 25 years.

»

George M. Giltinan, 62, a director of Seismograph Service Corporation, died August 3 in Victoria Harbor, Ontario, Canada. He had been with Seismograph Service Corporation since 1933, except for two years from 1937 to 1939 when he was employed in the geophysical department of Magnolia Petroleum Company.

George M. Giltinan

»

Alfred J. Wells, 60, retired Carter Oil Company tax attorney, died July 12 in Tulsa. Wells, who retired in 1946 after 26 years with Carter, came to Tulsa in 1920 from El Reno.

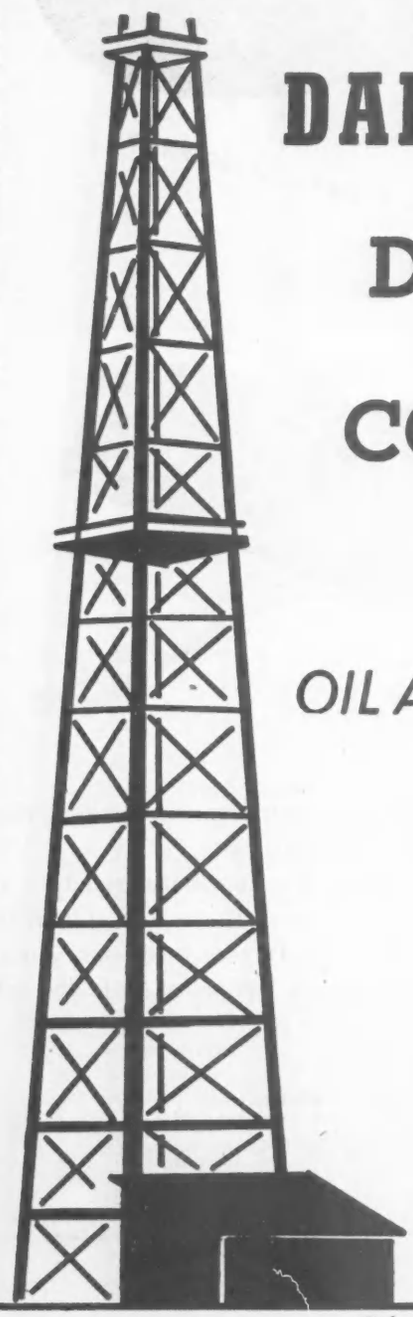
»

Maple Taylor, 53, of Chase, Kans., assistant superintendent of the Kansas division for the Gulf Oil Corporation, died August 1.

»

Charles H. Wingate, 79, of Tulsa, died August 1. He had been associated with the Monarch Gasoline Company and the Colson Oil Company as a lease superintendent until his retirement in 1941.

DAN L. CLARK W. M. AVERILL RUPERT COX



DAN L. CLARK DRILLING COMPANY

Drillers of OIL AND GAS WELLS

POWER AND STEAM RIGS

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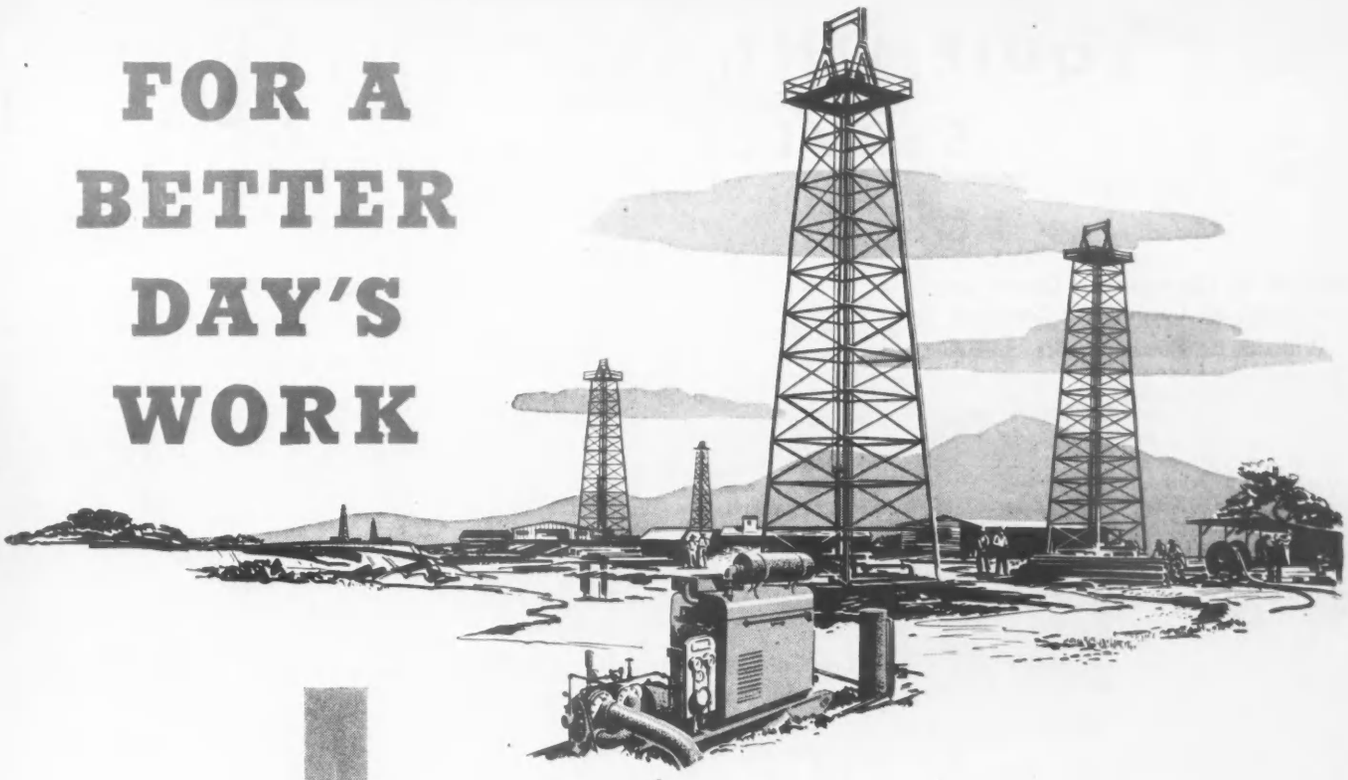
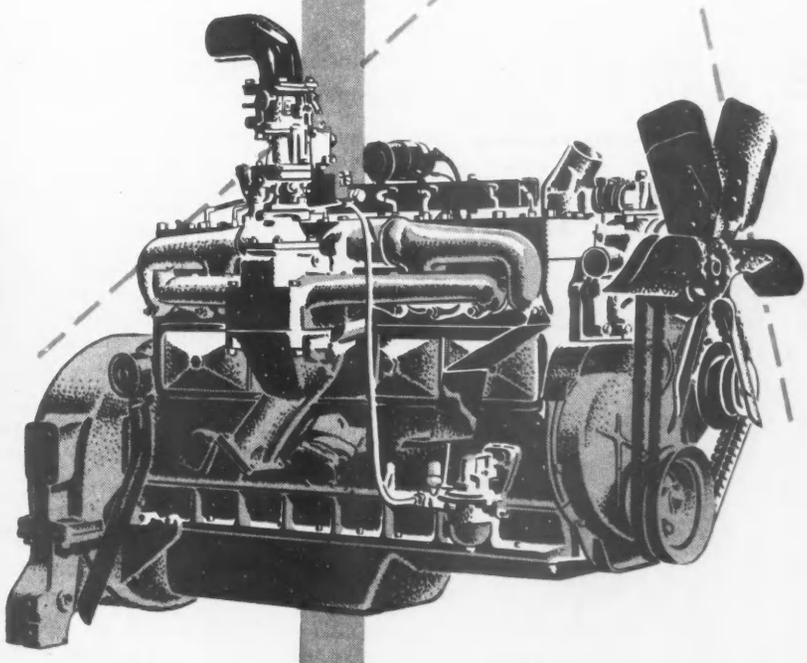
Local 7746—7747 Long Distance 95

FOR A BETTER DAY'S WORK



IN OIL FIELDS — ON FARMS — IN FORESTS — IN INDUSTRY AND ON THE HIGHWAYS!



● Today, as never before in our history, oil production is of key importance to the nation. Powered equipment which pumps "black gold" out of the earth must give peak performance in the vital job that lies ahead. That's why Chrysler Industrial Engines are specified in so many makes of powered equipment—why they're called on for the toughest tasks around drilling rigs. Their horsepower has a pedigree of unfailing performance, backed by Chrysler's engineering and production skill. Yes, wherever gasoline engines are depended upon for flexible, economical power, users are finding that Chrysler Industrial Engines are *Built For A Better Day's Work!*

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INDUSTRIAL ENGINE DIVISION, CHRYSLER CORP., 12200 E. JEFFERSON, DETROIT 31, MICHIGAN

EQUIPMENT AND SERVICE SUPPLIERS' NOTES

William E. Corrigan To Direct Sales For American Locomotive Company

William E. Corrigan, vice president of American Locomotive Company, has been placed in charge of sales of the Locomotive division, including direction of all sales activities of district sales offices. He will have offices in Schenectady, N. Y., and will also maintain an office in New York City.

William E. Corrigan

Corrigan began his Alco career at Schenectady in 1909. In 1915, he transferred to Alco's former plant at Paterson, N. J., as assistant engineer. After service in World War I he became ordnance district chief and chairman of the Claims Board of the Rochester ordnance district.

He rejoined Alco in 1920 in the New York sales office. He was appointed district sales manager for the Pacific Coast at San Francisco in 1923 and at Cleveland in 1930, opening the company's sales offices in these cities. He was appointed assistant vice president in charge of Alco's railway steel spring division in 1935 and in 1937 became vice president of sales of that division.

In World War II, serving as vice president in charge of miscellaneous munitions and Diesel engine division, contract cancellations, he negotiated contracts amounting to over a billion dollars, being largely responsible for Alco's contracts with the government. He was vice president of Eastern regional sales until his recent appointment.

C. Lee Cook Manufacturing Company Names Boulden to Engineering Staff

Marion A. Boulden has been appointed to the sales-engineering staff of the C. Lee Cook Manufacturing Company. Boulden formerly served for a number of years as a power engineer with the DuPont interests.

He will eventually make his headquarters at Charleston, W. Va., and will serve the natural gas, chemical, steel, and associated industries.

Roscoe Ayers Elected Vice President And Sales Manager of Bovaird Supply

Roscoe G. Ayers has been elected vice president and general manager of sales of Bovaird Supply Company. He has been general manager of sales of Bethlehem Supply Company for the past ten years.

Roscoe G. Ayers

Ayers has been in the oil well supply business since he joined Link Belt Company of Philadelphia in 1918. In 1920 he joined Clark Brothers Company, Olean, N. Y., specializing in the sale of drilling engines. He joined National Supply Company in 1922 and was division engineer from 1927 to 1936, and assistant to the division sales manager during 1937 and 1938. In 1938 he accepted the position of general manager of sales of Bethlehem Supply Company, which position he held until he accepted the general sales management of Bovaird.

The National Supply Company Names McKinney Executive Vice President

Arthur W. McKinney of Toledo, vice president and general manager of sales of The National Supply Company, has been elected to the newly created position of executive vice president of the company.

McKinney joined National Supply Company as a salesman in 1920 and became vice president and general manager of sales in 1940. A specialist in petroleum problems, he held advisory positions in that field during World War II, serving as a member of Industry Advisory Council, PAW, and Materials Subcommittee, Petroleum Industry War Council.

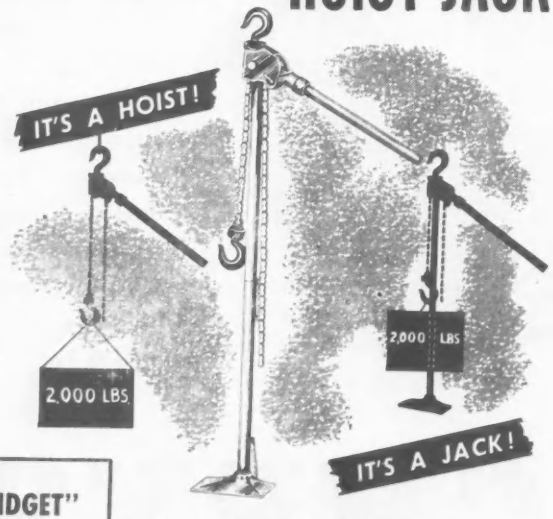
Uhrich Named Engineering Manager Of Goodyear Tire & Rubber Company

Martin B. Uhrich, Akron, has been named engineering manager of Goodyear Tire & Rubber Company's Los Angeles plant where he was engineering manager from 1930 to 1940. Uhrich, whose latest position was as analyst of equipment maintenance at the Akron plant, has been with the Goodyear company for nearly 30 years.

Martin B. Uhrich

Lift or Pull— EASIER AND FASTER with the NEW COFFING HOIST-JACK

This new Coffing Hoist-Jack is the 3-in-1 tool you need to save time and money—safely—on scores of lifting, pulling or stretching jobs in shop or factory. Use it as a jack, as a hoist or as a load binder. Moves machinery, lifts trucks, cars or equipment. Workmen like its easy operation. 2,000 pounds capacity; weighs only 23 pounds complete; Safety tested to 100% overload.



The NEW "MIGHTY-MIDGET" PULLER

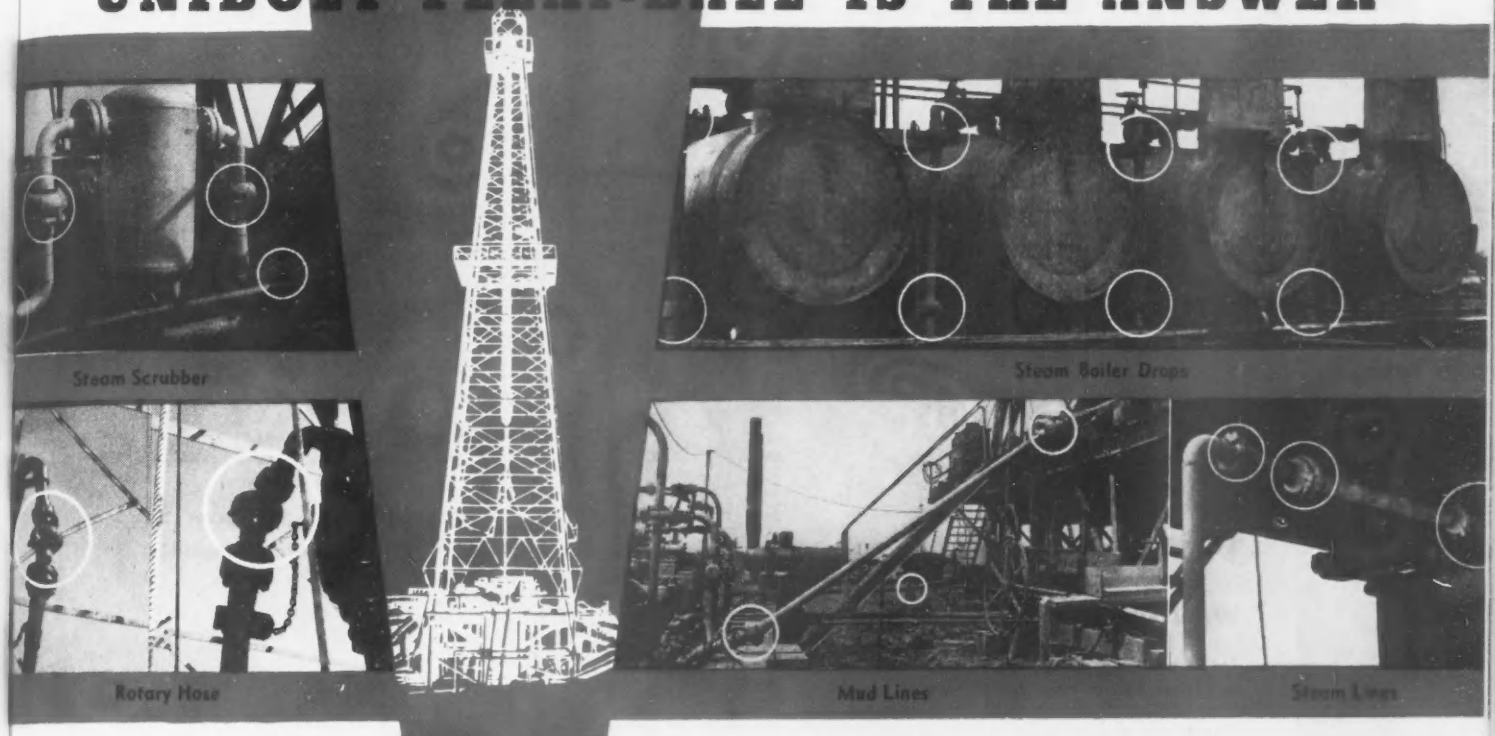
Coffing scores again with this new Puller that weighs only 6½ lbs. but lifts or pulls a *500 lb. load!* Easy to carry; easy to use—two-way handle operates as a lever or high-speed crank. Little head-room needed.

Write for Illustrated Bulletins on these and other Coffing products—SAFETY-PULL RATCHET LEVER HOISTS • QUICK-LIFT ELECTRIC HOISTS SPUR GEARED HOISTS • DIFFERENTIAL CHAIN HOISTS • I-BEAM TROLLEYS

COFFING HOIST COMPANY
Danville, Illinois

FOR LINES THAT "get out of line"

UNIBOLT FLEXI-BALL IS THE ANSWER



UNIBOLT
THE ONE PIECE COUPLING

Right—the special male by female Flexi-Ball Joint for rotary hose. It swings 45 degrees maximum.

The Flexi-Ball Joint, which provides for misalignment up to 38 degrees, depending on the size of the joint, is designed to relieve lines of stress resulting from expansion, vibration, or misalignment. It is a "natural" for flexible manifolds.

The proven UNIBOLT coupling principle is employed to join the component parts of this fitting. As a result, trouble due to galling and freezing of threads is entirely eliminated by the Flexi-Ball design. It is assembled by the simple process of tightening one bolt with an end wrench. Even after extended periods of service, the joint can be quickly dismantled by releasing the bolt.

This fitting may be used safely in any service, since it is made in steel only. Its sizes range from 1½" to 6" and test pressures to 6000 lbs., depending on size; 500 lbs. steam working pressure.

THORNHILL-CRAVER COMPANY
HOUSTON, TEXAS

UNIBOLT *Flexi-Ball* JOINT

Pipe Line Engineering & Equipment Company Named Alston Distributor

Pipe Line Engineering & Equipment Company, Houston, has been appointed exclusive distributor of the Alston ratchet pipe cutter manufactured by Alston Manufacturing Company, Livingston, Texas, which has recently organized as a corporation and expanded its plant facilities.

The company formerly operated as Alston Machine Shop. Victor and John Alston have joined with their father, H. D. Alston, as active members of the new organization.

Cunningham and Ferguson Elected Vice Presidents of Republic National

B. A. Cunningham Jr., a petroleum engineer in the Republic Bank Oil Department since 1936, has been elected vice president of the Republic National Bank. A graduate of Cornell University, Cunningham is a member of the American Institute of Mining Engineers and The American Association of Petroleum Geologists.

J. Howard Ferguson, president of the U. S. National Bank, Denver, also has been elected vice president of the Republic National Bank. Prior to his association with the Denver bank, Ferguson was with General Electric Company; National Bank of Commerce, New York; French American Banking Corporation, New York; and the Commercial National Bank and Trust Company, New York.

Franks Manufacturing Corporation Names A. H. Knight Sales Manager

A. H. Knight has been appointed sales manager of the Franks Manufacturing Corporation of Tulsa. Knight has spent more than ten years with major supply stores and has had considerable field experience since becoming identified with the petroleum industry in 1929. He was with the Oil Well Supply Company for eight years and with the International Derrick and Equipment Company 1½ years.

A. H. Knight

Hinderliter Tool Company Reopens Store in New Iberia, Louisiana

Hinderliter Tool Company, a division of H. K. Porter Company, has reopened its store in New Iberia, La. The store will be under the management of E. L. McGee.

President of Page Oil Tools, Inc. Completes Mid-Continent Field Trip

John S. Page, president of Page Oil Tools, Inc., Long Beach, Calif., has returned from an extended trip throughout oilfields in Oklahoma, Mississippi, Louisiana, Texas, and New Mexico.

Page's trip was started immediately following the International Petroleum Exposition in Tulsa where the Page tension type tools were on exhibit. The great interest shown in his products at the Oil Show and resulting requests for additional information and practicability of Page tools in the various fields of the Mid-Continent prompted the inspection trip.

John S. Page

J. Robert Baier Named President Of Crating and Construction Company

Houston Export Crating & Construction Company, Inc., has changed ownership with J. Robert Baier as new president. Other officers are William Peacock, vice president; L. F. Paul, secretary-treasurer; and H. C. Thomas, general superintendent.

Use Acme Cable Tools

TRUSTWORTHY SINCE 1900

Fig. 208 Acme Side-Slot Comb. Socket

Socket Slips

WANTED! TOUGH FISHING JOBS

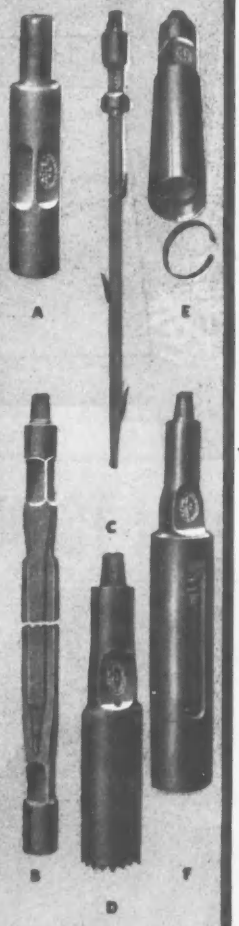
For 48-years, Acme's Trustworthy Tools have helped Drillers recover — more quickly — stuck tools on, even, toughest fishing jobs. Our Combination Sockets are especially adept at this arduous toil.

Their distinctive design and precisioned construction embody the accumulated, life-time experiences of Acme's own fishermen . . . Specialists whose services are ever in demand when drilling tools are "hopelessly" stuck.

From billet to finished Socket, Acme's famous "quality-comes-first" policy is rigidly enforced: Premium-grade steels — to our own analyses specifications — for ruggedness exceeding each tool's field requirements . . . Forgings EXACTLY heat-treated, by electro-automatically controlled process . . . Craftsmanship to minutest engineered detail.

Acme Combination Sockets have that uniform, built-in character so essential for hard jarring . . . Correct spacing, depth, angle and hardness of slip-wickers — also unique design of slips and slip-seat taper — all unite for maximum up-jarring, with minimum bursting stress.

More of EVERYTHING You Need in an Acme String . . .



A—Babcock Rope Socket
B—Fishing Jar
C—Center Spear
D—Drill Mill
E—Ring Collar Socket
F—Full Circle Slip Socket

See Acme's new Catalog insert in Composite Catalog (Vol. 1) — or write us TODAY for full information on any Cable Tool needs.

See panel (right) for other Acme Fishing Tools—for that EXTRA service you prefer.

Acme Fishing Tool Co.
PARKERSBURG, W. VA.
Export Office: 19 Rector St., New York 6, N. Y.

ACME DRILLING & FISHING TOOLS Since 1900

Sure Sign OF EFFICIENT EMULSION-BREAKING

THE Visco formula number on its products is your assurance of exact uniformity .... from month to month—year to year. Inside the blue barrels are efficient chemicals of *reliable* quality. Your Visco Representative can prove these statements to you... Ask him to do it. Soon.

VISCO PRODUCTS COMPANY
INCORPORATED
City National Bank Building
Houston 1, Texas

Visco **DEHYDRATING AND DESALTING CHEMICALS WHEREVER COST AND EFFICIENCY COUNT**

NOTICE: Visco Products Company is authorized to manufacture and sell Visco Oil Treating compounds for use in the breaking and resolving of oil emulsions, and to grant licenses for such use, under the following United States patents: 1,860,562; 1,860,563; 1,912,330; 1,937,253; 2,050,639; 2,050,640; 2,209,589; 2,214,782; 2,214,784; 2,225,189; 2,305,414; 2,307,813; 2,318,034; 2,318,035; 2,321,046; 2,335,554; Re. 20,717 and patents pending. Any purchaser of Visco Oil Treating compounds is authorized to use the same in the treating, breaking and resolving of oil emulsions in accordance with the above patents. The royalty for such use is included in the purchase price. Visco Products Company is authorized to and is willing to grant licenses on a royalty basis, to all companies, and to others desiring to practice the patented subject matter, under any and all of the above patents, permitting the user to purchase the oil treating compounds at will from any vendor, and to prepare the compounds for use under the above patent or patents, at a royalty charge of 28 cents per gallon. Application for license should be made to **Visco Products Company**, Houston, Texas.

QUICK REPAIRS ON
CONDENSERS
and
HEAT EXCHANGERS

If you need condenser or heat exchanger repairs in a *hurry* call us. We specialize in fast, high quality work.

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"Service, Not Promises"
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SHREVEPORT, LOUISIANA

Standco
NO-SMOKE
STANDCO BRAKE LINING
Stands the gaff and gets the job done without scoring brake rims. See pages 3973-3978, Composite Catalog.
Standco Brake Lining Co.
HOUSTON

BE SURE TO CHECK
The Trading Post
PAGE 293

EQUIPMENT and SERVICE SUPPLIERS' NOTES

W. E. Stiles Promoted to Manager Of Sales for Core Laboratories, Inc.

W. E. Stiles, former Gulf Coast division manager in Houston for Core Laboratories, Inc., has been recently promoted to manager of sales.

W. E. Stiles

Stiles was employed by Core Lab in 1942 as a field engineer specializing in field testing work. During the past six years he has held positions as reservoir engineer in the Engineering department and as division engineer of the North Texas division. Prior to his association with Core Lab, he was engaged in coring equipment sales and service and subsurface engineering work.

Headquarters of Frank Bohen Moved To Oil Well Supply Office in Chicago

Headquarters of Frank A. Bohen, division engineer, refinery and pipe line equipment sales for Oil Well Supply Company's Eastern division, have been moved to the division sales office in Chicago. Bohen has been located at the Eastern division headquarters offices in Columbus, Ohio.

Bovaird Supply Company Marks 77th Year With Opening of Store

The opening of a new store at Duncan, Okla., on Thursday, August 19, marked the 77th year of Bovaird Supply Company. The new store, carrying complete stocks of oil field supplies and equipment with complete sales and field service, is the seventeenth store and office maintained by the pioneer supply firm in Illinois, Kansas, Oklahoma and Texas.

The formal opening at Duncan was attended by company officials and representatives of many of the firms whose products are distributed in the oil industry by Bovaird.

Robert W. Eiler Elected Director Of The National Supply Company

Robert W. Eiler, secretary and general attorney of The National Supply Company, has been elected a director of the company.

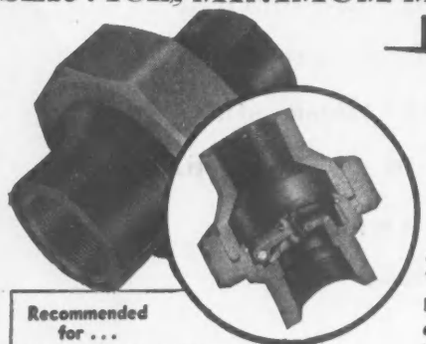
A graduate of Cornell University law school, Eiler practiced law in Chicago and Pittsburgh. He became general attorney for National Supply in 1937 and was elected secretary of the company two years later. He is also secretary and director of the National Supply Export Corporation, National Supply Company, Ltd., and National Supply Construction Corporation, and a director of Fretz-Moon Tube Company Butler, Penn.

GENERAL INDUSTRY
CHEMICAL & PROCESSING
OIL FIELDS
MINING
POWER PLANTS

Wherever piping dependability is a MUST...

CATAWISSA VALVES ARE THE ENGINEER'S PREFERRED CHOICE FOR TROUBLE-FREE SERVICE, MINIMUM MAINTENANCE COSTS!

LOOK AT THE ECONOMY HERE!



Eliminate the usual additional union and nipple on either outlet or inlet end of the line!

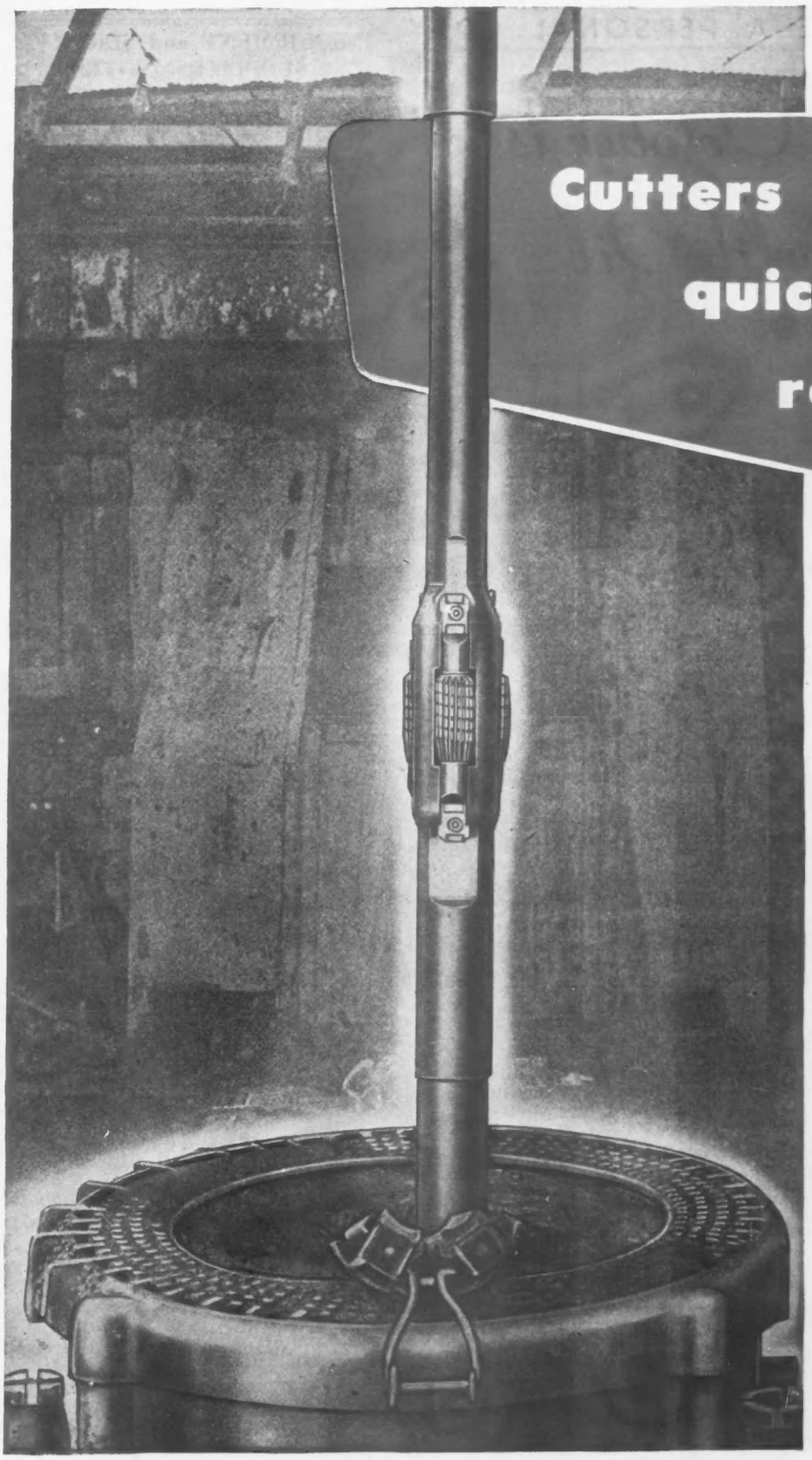
Double Extra Heavy Hot Forged Steel SWING CHECK VALVES

Pipe union type, especially adapted for high temperatures, extreme high pressure service, corrosive and acid conditions. Designed for perfect freedom of movement, with 100% opening. Stainless steel flapper and assembly, forged steel integral seat.

Recommended for . . .
600-lbs. Working Steam Pressure
1500-lbs. Oil, Water or Gas
Tested to 4000-lbs. NSHP

DISTRIBUTED BY
OIL WELL SUPPLY COMPANY
BRANCHES SERVING ALL OIL FIELDS
WRITE FOR BULLETIN 10-A
CATAWISSA VALVE & FITTINGS COMPANY CATAWISSA, PENNA.

HOT FORGED STEEL STAINLESS STEEL
UNIONS



Cutters quickly replaced

... right on the rig!

With CP Type B Reamers, on-the-rig replacements of cutters can be made rapidly and easily — thanks to a patented CP locking device.

Run above the bit, CP Reamers assure full, round and true gauge holes — and also straighter holes when the reamer is used as stabilizer or guide in drill stem.

Long service life is provided by unusually strong construction of cutters and pins. A wide range of cutter sizes can be furnished for each body size.

CP Type B Reamers are available in all popular sizes in either double or single stage reamers, with connections as desired.

Prompt service is assured throughout the Mid-Continent and Rocky Mountain fields.

CHICAGO PNEUMATIC TOOL COMPANY

MANUFACTURED AT FRANKLIN, PA.

GENERAL & EXPORT OFFICES: 6 EAST 44th STREET, NEW YORK 17, N. Y.

Oil Tool Sales Office: One N. W. 16th Street, Oklahoma City, Oklahoma

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Starting in October issue of World Oil

●

CAUSES AND PREVENTION OF DRILL PIPE AND TOOL JOINT TROUBLES

●

By H. G. TEXTER, Chief Field Engineer, Spang-Chalfant Division, National Supply Company
and
STANLEY MOORE, Engineer, Hughes Tool Company

With the years there has been no let-up in the demand for this series of articles which was presented originally as a paper before the A.P.I. in 1941, and published in The Oil Weekly the same year.

Now Texter and Moore have completely revised and brought up-to-date this drilling man's classic, as a timely and practical approach to eliminating drill pipe and tool joint failures.

The writers will outline and illustrate practically all the principal types of drill pipe and tool joint failures. When the cure is known, they will explain in full detail practical ways of eliminating the trouble.

Great demand for copies of this series prompts WORLD OIL to publish it again, with revised, last-word, how-to-do-it explanations based upon many years of experience in the study of drill-stem failures by the writers and by their operator friends.

HOW TO GET THE COMPLETE SERIES OF ARTICLES AT NO EXTRA COST

Be sure of having a personal copy of "Causes and Prevention of Drill Pipe and Tool Joint Troubles" always on hand for ready reference. If you are not a subscriber to WORLD OIL already, simply enter your subscription NOW to start with the October issue.

Every month WORLD OIL will bring you equally authentic and practical information about exploration-drilling-pipe line operations and management.

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I want to receive WORLD OIL. Here's my check for

☐ 3 years for $4; ☐ 2 years for $3; ☐ 1 year for $2

NAME_____ POSITION_____

COMPANY_____

STREET & NO._____

CITY & STATE_____

Check branch of industry

☐ Drilling Contractor ☐ Individual Producer
☐ Producing Company ☐ Manufacturing
☐ Pipe Line ☐ Supply

EQUIPMENT and SERVICE SUPPLIERS' NOTES

New Store in Alice, Texas, Opened By United Supply & Manufacturing

United Supply & Manufacturing Company has opened its 17th store, located in Alice, Texas, with a complete stock of supplies necessary for the operations of producing companies, drilling contractors, and pipe line companies. Twenty-four hour field service will be given by three field salesmen.

District office for the store is in Houston. The store is managed locally by Clifford Gilbert, assistant district manager, and Glenn Brents, store manager.

R. D. McBrian of Baker Oil Tools, Inc., Transferred From Odessa to Houston

R. D. McBrian, formerly West Texas district manager of Baker Oil Tools, Inc., with headquarters in Odessa, has been transferred to Central division headquarters in Houston as assistant division sales and service manager.

C. C. Taylor, formerly branch manager in Odessa, replaces McBrian. R. S. Bedillion, formerly branch manager at Victoria, has moved to Odessa as branch manager. C. A. Greve, formerly staff assistant at Houston, has been transferred to Victoria as branch manager. R. L. Ramby, formerly sales and service engineer in Corpus Christi, has been promoted to branch manager with headquarters in Corpus Christi.

C. C. Taylor

R. D. McBrian

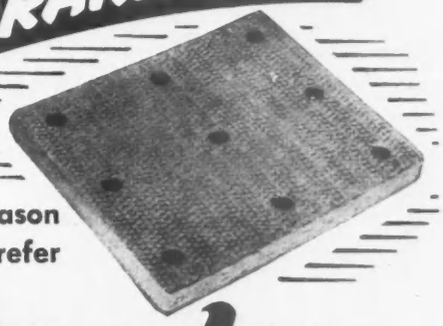
Mud Products, Inc., of Tulsa Organizes Sales, Equipment, and Export Divisions

To effect faster and more widespread service in furnishing the drilling industry with a convenient source of drilling muds, chemicals and mud handling equipment, Mud Products, Inc., of Tulsa, has organized three separate divisions. They include the mud sales division, handling mud and chemicals; the mud equipment division, selling and servicing mud handling equipment; and the export division, which will handle the sales and service of both mud and equipment in foreign countries.

Ralph S. Drummond Named Manager Of Crocker-Wheeler Electric Company

Ralph S. Drummond has been named manager of the Cincinnati branch office of Crocker-Wheeler Electric Manufacturing Company. Drummond comes to Crocker-Wheeler from the Dynamotor Corporation.

SMOOTHNESS OF BRAKING...



. . . another reason why drillers prefer

Standco NO-SMOKE BRAKE LINING

There's no grabbing when Standco Lining is used. It has a nice feed-off and slight lever pressure controls the heaviest strings of pipe.

More deep wells have been drilled with Standco than with all other blocks combined.

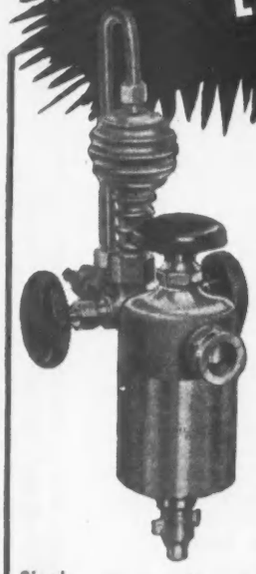
Be sure Standco No-Smoke Brake Lining is on all your rigs.

STANDCO BRAKE LINING COMPANY

Factory and General Offices

2701-2801 Clinton Drive — Houston, Texas

STEAM CYLINDER LUBRICATORS



Single Connection

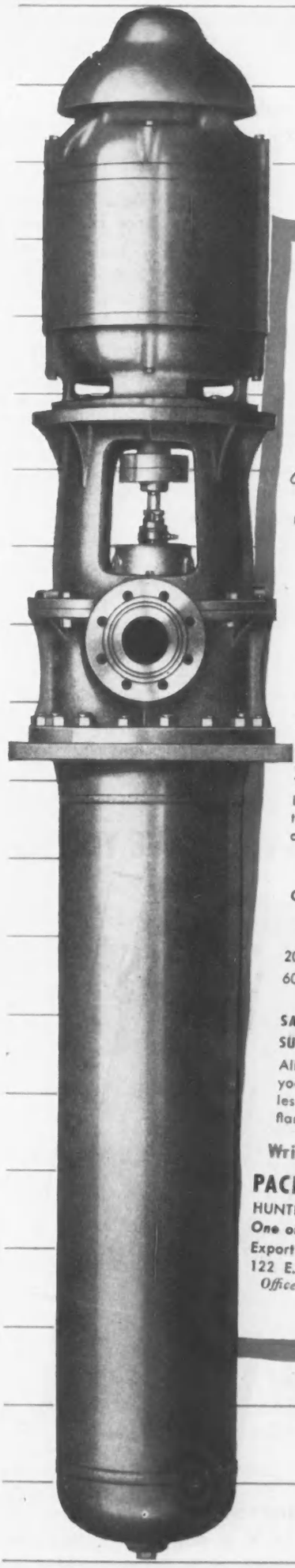
SWIFT LUBRICATORS

For years have been widely used by the oil producing and refining industry for cylinder lubrication on steam-driven slush pumps, boiler feed pumps, drilling engines and other similar equipment.

Simple, dependable and inexpensive, Swift Lubricators are especially suitable for use in cold, exposed weather service. The famous Swift bullseye sight-feed tells at a glance the rate of oil feed. This style of sight-feed eliminates leakage, repacking and glass breakage common with the tubular glass types.

Available in ½ pint, 1 pint and 1 quart sizes in both single and double-connection styles. Your supply house has them or can secure them for you.

SWIFT LUBRICATOR CO., INC.
27 Home Street, Elmira, N. Y.



To Reduce Construction Costs

Specify Pacific *Precision Built*

Type WY Vertical Centrifugal Pumps

SAVE BUILDING COSTS

That tight corner may be utilized without expensive alterations to the building. That new pump house may be smaller and less costly than for horizontal pumps of equal capacity.

GPM CAPACITY	FLR. SPACE IN INCHES
To - 200	18 x 18
200 to 600	24 x 24
600 to 1000	28 x 28

SAVE COST OF ELEVATING SUPPLY TANKS FOR NPSH

All a Type WY pump asks you to supply is 1 foot or less NPSH at the suction flange of the pump.

Write for Bulletin 105

PACIFIC PUMPS INC.
HUNTINGTON PARK, CALIF.
One of the Dresser Industries
Export Office Channin Bldg.
122 E. 42nd St., New York
Offices in all Principal Cities

V-1

Hunt Tool Company Completes Expansion Program at Corpus Christi

Expanded machine shop and field service facilities for Southwest Texas and Mexico have been included by Hunt Tool Company in a recently completed expansion program at the Corpus Christi plant, where R. H. King is division manager.

The enlarged Hunt Tool Company plant at Corpus Christi is the largest repair shop in Southwest Texas. Additional machinery and welding equipment has been installed at the new plant and a fleet of field welding trucks and boiler repair trucks have been added to the field service facilities. In addition, complete fishing tool and side wall coring services have been established.

Muse Joins Stewart & Stevenson To Promote Continental Engines

Willard B. Muse has joined the staff of Stewart & Stevenson Services and has been placed in complete charge of promoting Continental Red Seal engines in the state of Texas.

For 17 years Muse was associated with the Ford Motor Company sales promotion division, and for ten years thereafter he was connected with the power unit business handling Continental engines. He was Southwest sales manager for Continental and initiated the establishment of a Continental distributor organization in seven states. He was also instrumental in pioneering the manufacture of power units by Continental and was one of the first to put a Continental engine on an air conditioning job.

Dale Ruse Named Division Manager For H. C. Smith Oil Tool Company

Dale Ruse has been appointed division manager of Texas and New Mexico for the H. C. Smith Oil Tool Company. Ruse will make his headquarters at Odessa. He has been with the company for the past eleven years and was formerly branch manager at Oklahoma City.

Dale Ruse

Koppers Company Combines Divisions To Form Metal Products Division

General Brehon Somervell, president of Koppers Company, Inc., has announced the resignation of Allen W. Morton as vice president and general manager of the company's Piston Ring division. He also announced the consolidation of two company divisions to form a new Metal Products division, which will be composed of the former Shops division and the former Piston Ring division.

Louis W. Mason Named Assistant In National Tube Company Sales Office

Louis W. Mason has been appointed assistant to the general manager of sales of National Tube Company. Mason has been district manager of sales in Pittsburg, where he will be suceeded by Henry C. Hoar, formerly manager of sales at St. Louis.

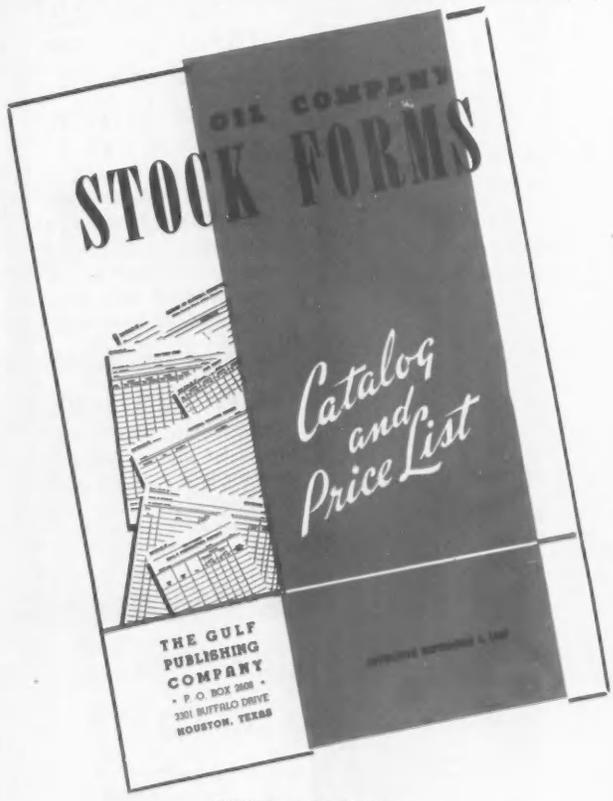
Mason was first employed by National Tube in 1923 in the purchasing department, becoming assistant purchasing agent. He became manager of purchases for the Tubular Alloy Steel Corporation in Gary, Indiana, during the war and later joined the sales department of National Tube in Washington, D. C. Hoar, a graduate of Massachusetts Institute of Technology, joined National Tube in 1927.

Glendon P. Robb will succeed Hoar as manager of sales in St. Louis.

H. V. Harder Transferred to Tulsa As Bethlehem Supply Representative

H. V. Harder, formerly district manager in the Rocky Mountain area for the Bethlehem Supply Company, has been promoted to special representative in the central sales office and has been transferred to Tulsa. He is succeeded by E. S. Lewis, formerly district manager in the Illinois area. G. B. Sager has been promoted to district manager in Illinois replacing Lewis.

THIS CATALOG WILL SAVE YOU $$



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The LEADER...for 25 years!

MILLER SAND PUMPS

And Regular Bailers

• Thousands of MILLERS in use Throughout the World!

• The Standard Clean-out Tool!

O. D. Sizes on MILLER SAND PUMPS are: 2½, 3, 3½, 4¼, 5, 5½ and 7 inches. Lengths are 20, 25 and 30 feet. The bail is welded to heavy seamless steel tube. Long heavy grooved plunger assures a liquid seal. Has three interchangeable bottoms. Wire line is direct connected to plunger—gives greater suction. DOES THE JOB! FAST! ECONOMICAL!

MILLER REGULAR BAILERS are made in 2½, 3, 3½, 4¼, 5, 5½ and 7 inch O.D. sizes and in 20, 25 or 30 foot lengths. Sectional Bailers made to your specifications. See Composite Catalog, page 2666, for prices, parts and details.

MILLER SAND PUMP CO.

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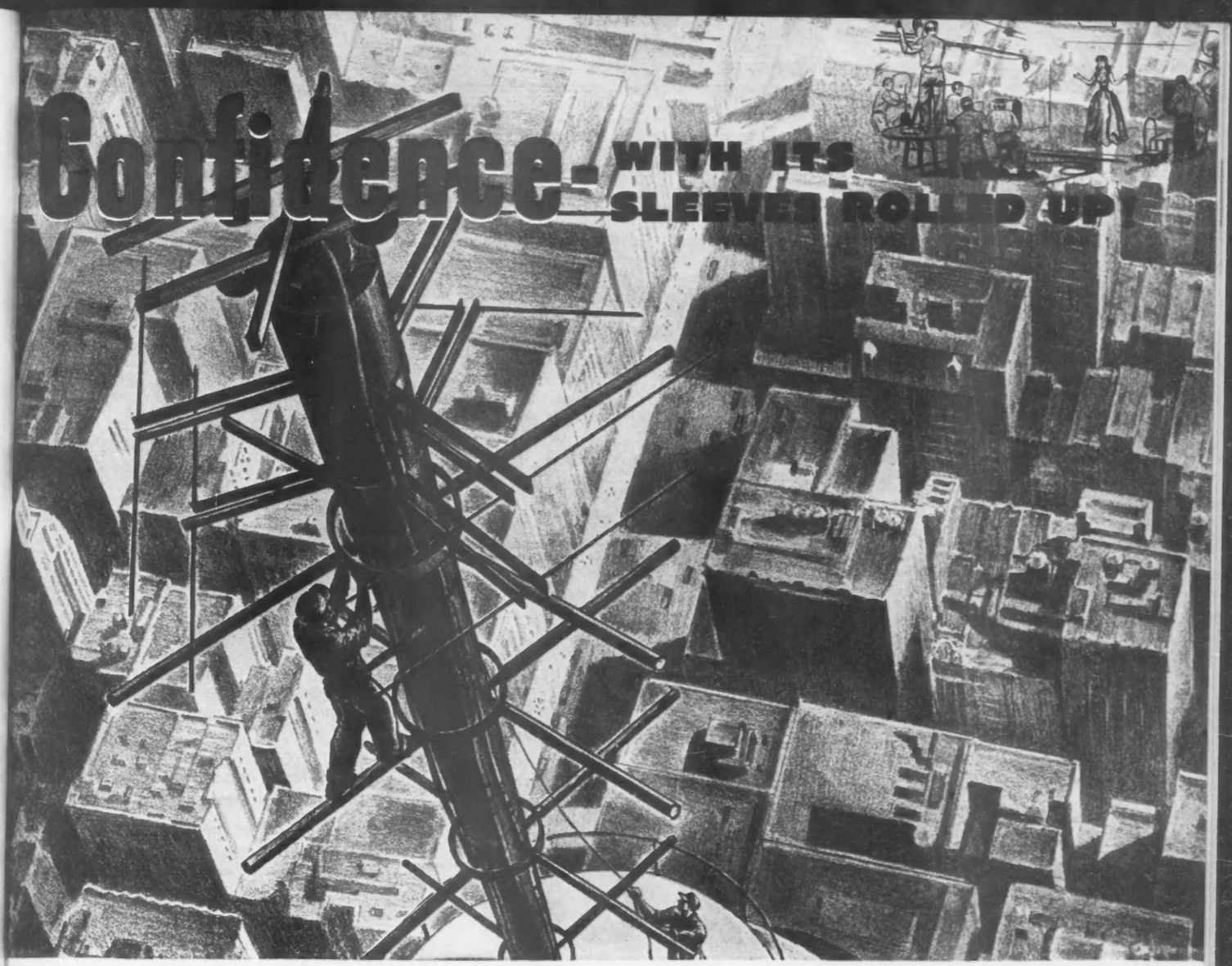
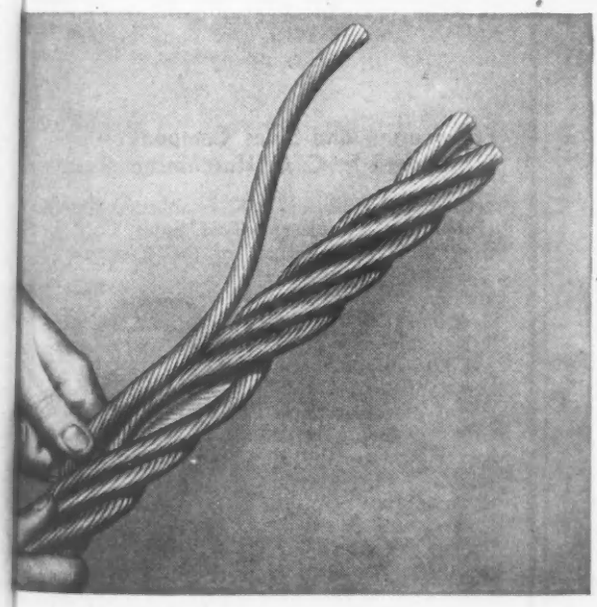
BOX 4516, OKLAHOMA CITY, OKLAHOMA

Export Office

30 Rockefeller Plaza, New York 20, N. Y.





ATOP THE WORLD'S TALLEST BUILDING . . . yet not high enough! Television's need for unobstructed, long-range broadcasts may be met by planes in the stratosphere, relaying signals from the earth. Engineers working on this problem are confident of ultimate success.

With like confidence, Roebling blazes new trails in developing and making products vital to communication and all other industries. And the widespread confidence reposed in Roebling is our most guarded asset. Leadership is maintained only by constant progress . . . our ideal is to make Roebling products and engineering service the best obtainable anywhere, *any* time.

WHEN TO SPECIFY ROEBLING *Preformed* WIRE ROPE

WHEN IT WILL SAVE YOU MONEY is the time to specify Roebling Preformed Wire Rope. Wherever wire rope is subjected to severe bending, Roebling Preformed is an outstanding money-saver. On thousands of installations it lasts far longer than Non-Preformed ropes . . . pulls down performance costs to an all-time low.

Great resistance to fatigue from bending helps give Roebling Preformed a long life, but you can chalk up other big advantages. Preformed is not inclined to twist and kink . . . is easy to handle and install. It can be cut without seizing. Broken wires lie flat . . . don't injure hands or chew up drums and sheaves.

Get your Roebling Field Man's advice about Preformed and the possibility of its saving you money. You can act on his suggestions with full confidence for he *knows* wire rope, how to choose the *right* one, how to maintain it for top service. Write or call him at your nearest Roebling branch office.

JOHN A. ROEBLING'S SONS COMPANY
TRENTON 2, NEW JERSEY
Branches and Warehouses in Principal Cities

Distributed by: **The National Supply Company**
Republic Supply Company

ROEBLING

ROEBLING

★ *WIRE ROPE AND STRAND* ★ *FITTINGS* ★ *SLINGS* ★ *SUSPENSION BRIDGES AND CABLES* ★ *AIRCORD, AIRCORD TERMINALS AND AIR CONTROLS* ★ *AERIAL WIRE ROPE SYSTEMS* ★ *ELECTRICAL WIRE AND CABLE* ★ *SKI LIFTS* ★ *HARD, ANNEALED OR TEMPERED HIGH AND LOW CARBON FINE AND SPECIALTY WIRE, FLAT WIRE, COLD ROLLED STRIP AND COLD ROLLED SPRING STEEL* ★ *SCREEN, HARDWARE AND INDUSTRIAL WIRE CLOTH* ★ *LAWN MOWERS*

Robert R. Kidd Named Chief Chemist At Goodyear Plant in Buitenzorg, Java

Robert R. Kidd has been appointed chief chemist at the Goodyear Tire & Rubber Company's plant in Buitenzorg, Java. Kidd joined Goodyear in 1943. His latest position was as chief chemist at the Goodyear plant in Topeka, Kansas.

Robert R. Kidd

Hobart C. McDaniel Named To Head Westinghouse Technical Press Service

Hobart C. McDaniel has been appointed manager of the technical press service in the public relations department of Westinghouse Electric Corporation, Pittsburgh. He will be responsible for the company's publicity in the technical and trade magazines.

McDaniel succeeds Carl E. Nagel, who has resigned to join McGraw-Hill Book Company in New York as editor of mail sales books for the engineering and industrial fields.

Seismograph Service Corporation Creates Rocky Mountain Division

Carl W. Blakey has been appointed manager of Seismograph Service Corporation's newly created Rocky Mountain division with offices located in Denver.

Carl W. Blakey

Blakey attended Colorado School of Mines and Oklahoma University and was employed by Seismograph Service Corporation in 1936. In 1937 he was promoted to party chief and placed in charge of a crew operating in Persia where he remained until his return to the U. S. in 1939. In 1945 Blakey was placed in charge of a crew operating in Iraq and a few months later was promoted to manager of the company's Middle East operations with headquarters in Cairo, Egypt, where he lived until his return to the U. S. in March.

Allis-Chalmers Manufacturing Firm Announces Retirement of Warner

G. William Warner, for the last 32 years chief inspector for Allis-Chalmers Manufacturing Company, has retired after 50 years of service. Warner was first employed by Allis-Chalmers as a machinist and in 1901 he was named chief inspector of the company's newly acquired Scranton, Pa., plant, the former Dickson Manufacturing Company.

Warner came to the firm's main works in Milwaukee in 1912 as hydraulic inspector and in 1916 was named chief inspector for the company.

Engineering and Sales Company Established by C. C. Hutchinson

C. C. Hutchinson has established the Hutchinson Engineering and Sales Company with headquarters in the Esperson Building, Houston.

C. C. Hutchinson

Holder of a degree in electrical engineering from Oklahoma A. & M., Hutchinson has a background of 22 years in geophysical work, including service with Geophysical Research Corporation, Seismograph Service Corporation, McCollum Exploration Company, and Engineering Laboratories, Inc. He is a member of the Society of Exploration Geophysicists, Society of Exploration Geophysicists, Houston Section, Houston Geological Society, and American (Army) Ordnance Association. He will represent Gordon Seismic Record Duplicator, Vector Manufacturing Company, Bailey Company, Ltd., and Electro-Technical Laboratories.

PARKERSBURG MACHINE Co. PARMACO PARKERSBURG, W. VA., U.S.A.

The House of Courteous Service

Ask Your Favorite Supply House to Furnish You with

PARMACO PRODUCTS

PACKERS	DRIVE SHOES
CASING SHOES	PLUGS
CASING HEADS	SWABS
CASING WAGONS	BOILER BURNERS

AND OTHER SPECIALTIES

Refer to COMPOSITE CATALOG . . . Pages 3329 to 3348

For Anything Special Contact

PARKERSBURG MACHINE COMPANY

PARKERSBURG, WEST VIRGINIA

Exclusive Export Distributor:

PETROLEUM MACHINERY CORPORATION

30 Rockefeller Plaza, New York 20, N. Y.

Murray Rubber

A TOUGH COMPONENT OF KEYSTONE PISTONS

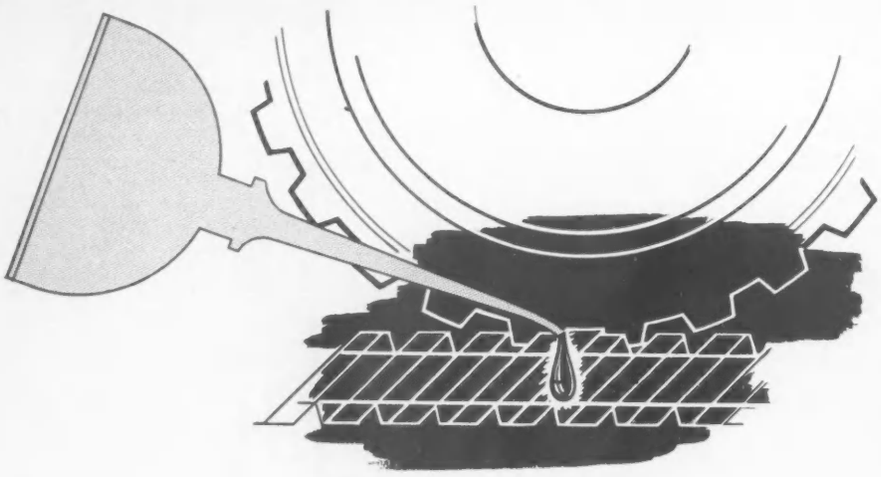
The All-Purpose Keystone Piston has fewer parts than any other similar type replaceable piston. Rubbers are interchangeable from 6" through 8" and 3½" through 5" on the same body.

The Universal Type Keystone Piston was designed especially for cement trucks and other high pressure pump service where a universal rod is necessary.

- Murray mechanical engineers worked in close collaboration with the engineers of Keystone Tool Corp., Houston, Texas, in the development of its piston, and furnished the proper compounds in both natural and Hycar rubber. These pistons, equipped with MURRAY RUBBER, have given superb performance under the most adverse pumping conditions encountered by slush pumps, cement pumps and other high pressure pumps used in the oil industry.

With the facilities of the largest, most modern and complete rubber manufacturing plant in the South and our staff of skilled engineers, we are in a position to help you develop new types of mechanical rubber equipment, or improve the rubber components of your present oil field equipment.

MURRAY RUBBER COMPANY
HOUSTON, TEXAS



Reputation for SERVICE

For more than a quarter of a century, the banks of Fort Worth have helped the petroleum industry convert ideas and plans into practical realities. Their close association with the Southwest's oil business has equipped them with a keen understanding of the oil man's problems and the necessary experience to fulfill his needs.

When financing any phase of oil and gas development, the banks of Fort Worth invite you to consider their reputation for SERVICE.

THE FIRST NATIONAL BANK
THE FORT WORTH NATIONAL BANK
CONTINENTAL NATIONAL BANK
UNION BANK AND TRUST COMPANY
TRINITY STATE BANK

MEMBER BANKS OF THE FORT WORTH CLEARING HOUSE ASSOCIATION

EQUIPMENT and SERVICE SUPPLIERS' NOTES

International Derrick and Equipment Company Makes Three Appointments

A. L. Woracek has been appointed export manager of sales of steel buildings, derricks, towers and machinery for International Derrick and Equipment Company. Woracek has been with Ideco for 23 years and has been associated with all phases of export operations.

B. V. Brown

A. L. Woracek

B. V. Brown is now located in the New York export office and will act as export manager of sales of machinery and supplies. Brown was formerly manager of purchases and stock control of Ideco's supply store division in Dallas. He has had 20 years experience in sales and purchasing with manufacturers and suppliers of equipment and was formerly connected with Frick Reed and Bridgeport Machine & Tool Company.

James E. McGuire, who for the past two years has been buyer in Ideco's Dallas export office, has been transferred to New York. McGuire will fill the position of export purchasing agent and office manager in the New York office. McGuire has handled phases of export business for Ideco since 1941.

General Electric Welding Divisions Moved Completely Within New England

The first complete large-scale welding equipment business to be located entirely within the New England states was completed recently when final components of the General Electric Company's Welding Equipment divisions moved to Fitchburg, Mass.

The Sales and Application Engineering divisions of the Welding Equipment divisions have now joined the d-c welder manufacturing plant in Fitchburg, Mass. This move, coupled with the prior establishment of the a-c welder factory in Holyoke, Mass., makes New England one of the major arc welding centers of the world.

Gerald G. Baker and Thomas B. Heck Named to Posts by Oil Base, Inc.

Gerald G. Baker has been appointed research chemist and Thomas B. Heck has been named service engineer of Oil Base, Inc. Baker will act as a liaison between field engineers and the laboratory on field problems, as well as testing and developing the company's new products.

Cementrol

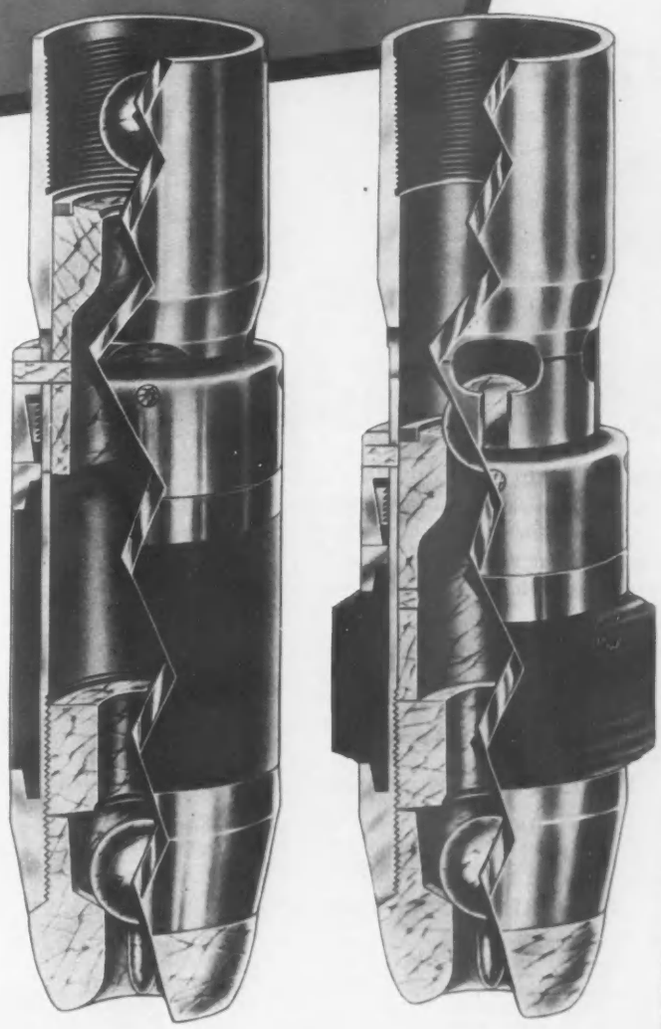
...standard method of preventing cement contamination of low pressure producing formations

CEMENTROL was designed specifically to do one job . . . to prevent cement contamination of producing formations . . . and do it better than any other existing equipment.

Best testimony to the effectiveness of CEMENTROL is the fact that the use of CEMENTROL equipment has steadily increased month after month. Many operators have standardized on CEMENTROL.

Oil company engineers who helped Larkin "cut the pattern" for this simple, safe, effective equipment insisted that it be as safe as conventional floating equipment. They got just what they wanted . . . and needed.

CEMENTROL meets every requirement for simplicity—safety—and effectiveness. CEMENTROL is sold by your supply store.



CEMENTROL equipment is being widely and effectively used in the extensive water floor operations now being carried on. If you are not yet familiar with CEMENTROL, please contact the Larkin Representative in your area or write for our CEMENTROL catalog.

LARKIN

...Through Your Supply Store

LARKIN PACKER CO., INC.

ST. LOUIS, MO.

WEATHERFORD SPRING GROUP — (Top) Left to right are Jess E. Hall, Sr., George Hall, Clay Miller, Ralph Hall, owner of Hall Machine Shop, Art Brumbly, Roy Swearinger, and Carl Parks. (Below) Officials of the Weatherford Spring Company shown after their acceptance of the seven planes at Wichita, Kansas, are left to right, John A. Hall, sales manager; Jess E. Hall, Sr., owner; Jess E. Hall, Jr., general manager; and Chester Hairston.

Announcing Our New 1948 Design . . .

"THE LUSTROUS SEVEN STAR BEAUTY"

World's Best Map Filing Cabinet

• CONVENIENT • INSTANT REFERENCE • SPACE SAVER • INSTANT FILING • DUST PROOF • RUST PROOF • MEDDLER PROOF

CAPACITY: 60-75-100-160-200

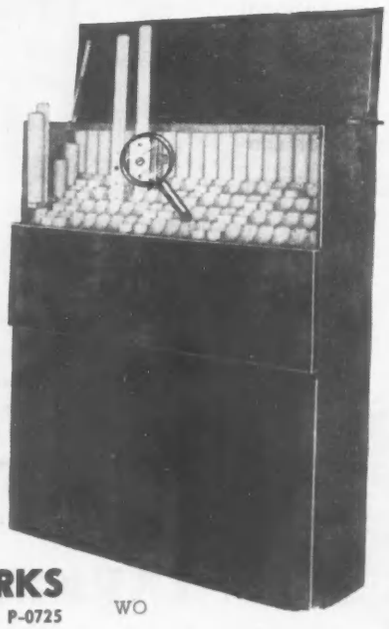
Ultra Attractive fits the furniture scheme of any office.

Instant Adjustment—for maps or tracings from 12" to 54" long. Each Well 2" x 2", equipped with individual wood slide with holes on 2" centers, through which one screw when matched to hole in adjustment block and tightened, automatically gives perfect alignment at top for all length maps. Substantial lock—Individually keyed.

Exterior of cabinet made of 3/4" five ply beautiful grained hardwood mitered locked joints, banded edges on door and top. Interior partitions 3/8" thick, and 1/4" slides, all three ply veneer of southern hardwood or fir.

Finished: Walnut, Oak, Mahogany, Olive Drab Green, Natural or Blond. Other type cabinets designed to suit your needs. Information on request.

We specialize in Drafting Tables and Light Tables made to your order.



PORT CITY CABINET WORKS

609-13 Quitman St. HOUSTON 9, TEXAS Phone P-0725

WO

Seven Beechcraft Bonanzas Bought By Weatherford Spring Company

Weatherford Spring Company of Weatherford, Texas, manufacturers of oil well cementing tools and other specialty items, have purchased seven Beechcraft Bonanzas to facilitate the operations of their field men and to speed delivery of materials vital to oil well completion jobs.

The following statement recently appeared in the *Beech Log,* house publication of the Beechcraft Corporation: "Operating 'The Red Fleet' of seven Beechcraft Bonanzas, Weatherford Spring Company owns the largest number of these four-place personal planes used by any business organization in the U. S."

A sidelight on this recent development at Weatherford Spring Company was the meeting in Los Angeles in July of the seven men shown above. These men, together for the first time in 13 years, all had a part in the manufacture of the scratcher invented by Hall in 1934.

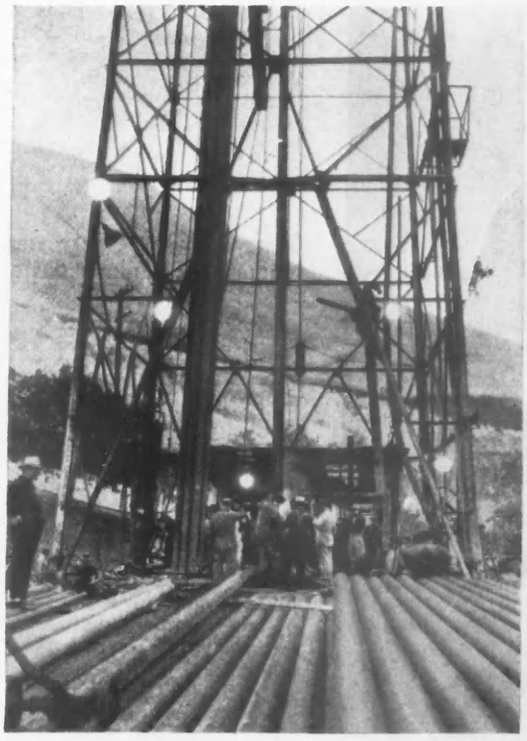
Consolidated Western Announces Formation of Construction Subsidiary

Harvey C. Cranfill, vice president of the Consolidated Western Steel Corporation, has announced the formation of the wholly owned subsidiary, Consolidated Western Constructors, Inc., with headquarters in the M&M Building, Houston. The officers of the construction organization are almost identical with the parent company, the exception being William E. Goodere, who has been elected vice president in charge of operations.

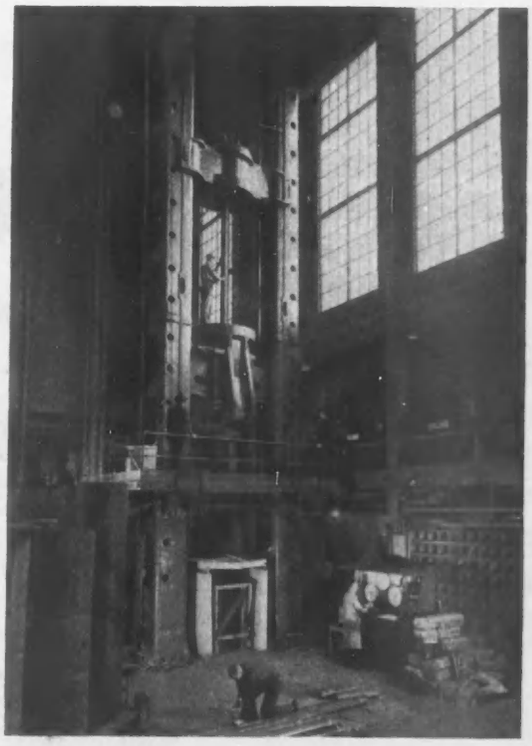
George F. Russell Jr., consulting chemical and petroleum engineer, has been named manager of the Natural Gas and Gasoline division. He was formerly associated with the Hudson Engineering Corporation, Standard Oil Company of New Jersey (Louisiana division), and Phillips Petroleum Company. He also was assistant professor of chemical engineering at the University of Oklahoma and associate professor of natural gas and petroleum engineering at Louisiana State University.

Thomas C. Main is chief chemical and process design engineer. He was formerly chemical engineer in charge of research and development for Fomac Engineers, petroleum chemical consultants in the McCarthy chemical and absorption plants at Winnie, Texas. Prior experience was with Esso Laboratories of the Standard Oil Company of New Jersey (Louisiana division), where he served for five years as a chemical engineer.

Dependability THROUGH *Research*



IN THE FIELD: Setting up 1133 feet of 8⅝-inch SMITHway Casing; at Santa Barbara, Cal.



IN THE LABORATORY: Pull-out characteristics of SMITHway Casing are constantly tested.

SMITH*way* CASING · LINE PIPE

A. O. SMITH CORPORATION

New York 17 • Pittsburgh 19 • Atlanta 3 • Chicago 4 • Tulsa 3 • Dallas 1
Houston 2 • Seattle 1 • Los Angeles 14 • International Division: Milwaukee 1

Both are tools of precision. Throughout the design and manufacture of precision-built WECO Drop-Side Blocks, micrometer precision . . . precision that pays off in longer, more dependable block service . . . is maintained in every operation. WECO Blocks are truly the finest and most dependable block that can be built for its capacities. Specify WECO Blocks! They are positively snarl-proof and provide greater convenience and flexibility in use than any other block.

WELL EQUIPMENT MFG. CORP.
Subsidiary of Chiksan Company
Houston 1, Texas
Exclusive Sales Representative Outside Mid-Continent Area
CHIKSAN COMPANY
Brea, Calif. New York 7
Export Sales: CHIKSAN EXPORT COMPANY, Brea, Calif. New York 7

WECO
Manufacturers and Distributors of Oilfield, Refining, Marine and Industrial Equipment

EQUIPMENT and SERVICE SUPPLIERS' NOTES

Largey Named Advertising Manager Of Byron Jackson Oil Tool Division

W. E. Largey has been appointed advertising manager of the Oil Tool Division of Byron Jackson Company. He assumed his responsibility following the International Oil Exposition at Tulsa. Largey will continue as advertising manager at the Patterson-Ballagh Division of Byron Jackson Company. He has worked in the California oil fields and in advertising since 1939.

W. E. Largey

Tube Turns Opens Factory Warehouse In Tulsa With R. S. Tyler in Charge

Tube Turns, Inc. has established a modern factory warehouse in Tulsa with Robert S. Tyler, Mid-Continent district manager, in charge of the new project. William R. Emrich, who was transferred from the Louisville sales department to Tulsa, is chief clerk. W. J. Hamilton is the factory-trained warehouse foreman.

Sperry-Sun Well Surveying Company Names A. B. Palmer General Manager

Arthur B. Palmer has been appointed general manager of the Sperry-Sun Well Surveying Company. Palmer joined the parent Sun Oil Company as an engineer at Maracaibo, Venezuela, in 1922, immediately after his graduation from the University of Illinois. He joined Sperry-Sun as a sales and service engineer in 1929 and in 1938 he was named district manager for the company. Since August, 1947, he has served as general sales manager with headquarters at Houston.

Arthur B. Palmer

Lincoln Electric Company Authorizes Field Service Shops Throughout U. S.

The Lincoln Electric Company of Cleveland, Ohio, manufacturer of arc welding equipment, is authorizing service and repair organizations in the principal industrial centers of the U. S. to be field shops for Lincoln Equipment.

Each field service shop is sending men to the Cleveland plant for training as experts in the repair and service of Lincoln welders of all types. These men will not only make repairs in their respective organizations but will be available for preventive maintenance service.

WORLD OIL'S Trading Post

CLASSIFIED ADS

SERVICES · PERSONNEL · USED EQUIPMENT

Rates: Regular Classified (undisplayed) set in this size type: 10 cents per word. If Box Number is to be used count an additional six words. Replies forwarded without charge. Situation Wanted: 5 cents per word. Display advertisements, set in suitably larger type with ruled border: $9.00 per column inch per insertion. Situation Wanted: $4.50 per column inch. **All classified ads payable in advance.** 10% Discount if 3 or more insertions are ordered at one time. **COPY DEADLINE:** 5th of month preceding date of issue. Send copy and checks to: Trading Post Section, World Oil, P. O. Box 2608, Houston, Texas.

FOR SALE

FOR SALE
Rotary drilling rig complete.
Cardwell Drawworks.
International and Waukashaw motors.
Gardner-Denver pump.
4½" drill pipe.
Oil well bath rotary table.
1600 gallon butane tank.
96 foot mast and all equipment complete necessary for drilling operation.
Now operating in western Kentucky. Priced to sell. Contact Ashby Bros. Drilling Co. 1906 St. Clair Avenue, East St. Louis, Illinois.

It's New... Check It!

PIPE GRINDING MACHINE designed and built to give pipe line contractors maximum service in polishing the bevel on plain end pipe in preparation for welding. The machine can be placed on pipe easily and quickly, and will clean the bevel on 24-inch pipe in 15 seconds, whereas a man with file would have to work at least 15 minutes. The grinder is constructed for durability, light weight, effectiveness and economy. Electrically driven, it may be operated from electric welding machines on the line.

The Machine was perfected, and now being manufactured by

WICHITA TOOL REPAIR CO.
of Wichita Falls, Texas
Under license from O. R. Hall, inventor.

FOR SALE

Wilson giant rotary drilling rig, 90 foot mast. Powered 120 H. P. International, 7x14 Gardner-Denver pump. Powered 120 H. P. Allis-Chalmers. Complete with all tools, no drill pipe. $26,000.00 f. o. b. Roswell, New Mexico. Contact Donald Brown 125 W. 4th, Roswell, New Mexico. Phone 2973.

For Sale—Marmon Herrington model 555-4 all wheel drive truck with 8 ton rating, complete with Hercules RXC six cylinder engine. Westinghouse brakes. 11.00x20 tires. Ideal as tractor or bobtail off and on highway where traction is required. Further details by application to TRUCK EQUIPMENT SALES CORPORATION, 2815 Navigation, Houston, Texas. Phone C 4-0481.

DRILLING equipment, reconditioned ready for delivery, Failing, Longyear, Franks, Eli Tulsa, American, Sullivan, Ft. Worth, Wichita, Keystones, National, Standards, also steel derricks, cable tools, cable and good used casing, most sizes. Pressey & Son, Pueblo, Colo.

READ THE TRADING POST FOR SALES AND SERVICES

FOR SALE

FOR SALE

Large or small quantities
ALL NEW

6" Wheatley Gate Valves, 500 lbs. W.P., Iron Body, Brass Trim, Flanged, Extra Heavy, Series 30. Priced @ $37.50 each.
6" Wheatley Combination Gate and Check Valves, 500# W.P., Iron Body, Brass Trim, Flanged, Extra Heavy, Series 30, Priced @ $55.00 each.
4" Wheatley Gate Valve, 500# W.P., Iron Body, Brass Trim, Flanged, Extra Heavy, Series 30. Priced @ $27.50 each.
4" Wheatley Combination Gate & Check Valves, 500# W.P., Iron Body, Brass Trim, Flanged, Extra Heavy, Series. Priced @ $47.50 each.
Accompanying Flanges for the above at a slight additional cost. Thousands of Victaulic Type Couplings, New. Ideal for your 6" Invasion Pipe.

MORRIS BROOKS SUPPLY COMPANY, INC.
Box 2756
1425-1600 So. Alamo Street
San Antonio, Texas
ALL MERCHANDISE F.O.B. SAN ANTONIO, TEXAS

HELP WANTED

Jobs Looking for Men

We are looking for ambitious agressive young men with engineering training and some field experience who believe they might like to take up selling as a career. Previous selling experience is not essential if you have the background and personality required to make a successful sales engineer.

We are one of the industry's oldest and best known manufacturers of drilling and producing equipment. We operate sales offices in every principal field in the country and are large enough to offer plenty of room for advancement to the right men.

If this sounds like the opportunity you've been looking for to increase your earning capacity and insure a more secure future write and tell us about yourself, mention salary you require to start, enclose your picture, and explain why you believe you would be successful in selling. Your reply will be held in strict confidence.

Address Box 75W,
c/o World Oil
Houston, Texas

FOR SALE

PARTS
FOR ARMY TRUCKS

New and Used

Largest stock in America, 6x6, 6x4, 4x4, 4x2. All items guaranteed. Largest auto wrecking house in the west with most complete stock of new and reconditioned parts for all cars and trucks. FAST SERVICE! Phone: Alpine 1711.

PIONEER
AUTO WRECKING CO.
776 West 13th Ave. Denver 17, Colo.

FOR SALE

One complete rotary drilling rig with all necessary equipment and tools. Completes hole at 3700 ft. Everything guaranteed good condition (priced to sell). If interested write for particulars or invoice at 607 State National Bank Building, Corsicana, Texas. Phone 863.

Used Le Roi 6-, 8-, and 12-cylinder gas engines complete and in A-1 condition for oil industry power. Priced to sell. Also one Model NKU Waukesha-$1500. Write or call today. General Machine & Supply Company, P. O. Box 72, Wichita Falls, Texas.

HELP WANTED

Well established, expanding seismograph company offers openings for thoroughly experienced central office interpreters, field party chiefs, observers and surveyors. Good salaries and opportunity for advancement. Please state in first letter type of position wanted, education, age, experience, salary expected and date available. Address: Box 60W, c/o World Oil, Houston, Texas.

HELP WANTED

WANTED

Man familiar with oil well drilling and production practices, preferably with foreign experience, wanted for opening in New York office of international manufacturer of oil tools. Excellent opportunity for right man. Salary measured by ability. Write details of training-experience. Prefer under 35. Include recent photo. Permanent. Address: Box 72W, c/o World Oil, Houston, Texas.

CHEMICAL ENGINEER

Desired by major oil company to supervise research work in high pressure phase relations of multicomponent hydrocarbon systems. Desirable that applicant also contribute to work on drilling muds. Excellent opportunity to man with proper technical background and leadership ability. Give full details in reply to P. O. Box 2819, Dallas 1, Texas.

ASSISTANT PROFESSOR to take charge of a newly created curriculum in petroleum production engineering in a southeastern university. Salary $3900 for nine months. Possibility of $900 more for summer work in research. Reply by letter stating personal data, education, experience. Address: Box 73W, c/o World Oil, Houston, Texas.

SITUATIONS WANTED

District Manager or field representative for oil field supplies and machinery, wire rope and pipe. Thoroughly experienced. Oklahoma City vicinity. Address: Box 74W, c/o World Oil, Houston, Texas.

LEASES, DRILLING, ACREAGE, ETC.

■ SEE A. L. BOWLES, ADA, OKLAHOMA, FOR SHALLOW DRILLING DEALS IN OKLAHOMA.

■ We will buy producing or non-producing oil royalties. Send particulars. Standard Security Co. 115 Broadway, New York 6.

"Due to circumstances and committments we are willing to sell six successful wells in the Lloydminster Blackfoot field of Alberta, Canada. We also hold leases on choice acreage including two offset and four second offset locations. Geologists reports, electologs, production reports and all necessary information available only to responsible parties. Apply, Robert Slutzky, 2132 Victoria Ave., Windsor, Ontario. Phone 3-2875."

PROFIT BY BUYING

ROYALTIES WHERE

THE PLAY IS HOT

AND PRICES LOW!

The Rocky Mountain area is seething and one of the hottest spots is east of the Rockies in Montana, southeast of Gulf's major strike near Glacier Park. The big companies are pouring in and the time to buy royalties is NOW—ahead of production. That is when the real profits are made. This firm is in its 25th year and specializes in AHEAD-OF-THE-DRILL royalties, in major company blocks. WRITE US TODAY! Landowners Royalties Company, Great Falls, Montana.

REAL ESTATE

BUSINESS AND RESIDENCE

For lease six room office or combination office and residence 50′ x 50′ shop or warehouse. Located on lot 150′ x 200′, 1 block off Wayside Drive, 2914 Pitzlin Street, Houston, Texas. Phone Woodcrest 6-6389.

EQUIPMENT and SERVICE SUPPLIERS' NOTES

FWD DEMONSTRATION—Field sales and service representatives observe demonstrations at the company's proving grounds.

Four Wheel Drive Auto Firm Holds Second Annual Salesmen's Convention

A story of greatly increased productive capacity, immediate doubling of the size of the engineering staff in order to accelerate the rate of product development, and of two new great truck models to sell was told to field sales and service representatives at the second annual convention held at the Four Wheel Drive Auto Company factory in Clintonville, Wis., in July.

Clinics on customer service were held during this three-day session, designed to make salesmen of greater value to their customers. The salesmen were welcomed to the second annual all-zone conference by Walter A. Olen, President of the company.

R. H. Schmidt, vice president in charge of sales, was keynote speaker, and R. A. Olen, general manager, told the salesmen of the progress that had been made by the company during the past year. He pointed out that $400,000 had been spent during the past year in manufacturing improvements.

Clifford B. Ives & Company Organized To Represent Manufacturers

Establishment of a new manufacturer's representative organization is announced with the formation of Clifford B. Ives & Company, in Philadelphia. This company has been selected by the Fisher Governor Company, Continental Equipment Company, Daniel Orifice Fitting Company, and others to represent them in Eastern Pennsylvania, Southern New Jersey and Delaware.

The company will be directed by Ives, who has been associated with Foxboro Company as research and development engineer.

Gulf Oil Corporation to Construct Service Station for Private Planes

Plans for a super service station for private planes, believed to be the first of its type in the U. S., have been announced by the Aviation department of Gulf Oil Corporation. A proposal to erect such a station at the Allegheny County Municipal Airport, near Pittsburgh, has been approved in principle by the County Commissioners there.

The proposed building, to cost about $25,000 to $30,000, will be approximately 70 feet by 30 feet, constructed of porcelain on masonry. It will contain a lounge and chart room with large map table and other navigational plotting facilities for private pilots.

The ramp area will provide a "service-island" where airport cabinet-type gasoline pumps will be installed. Two grades of aviation gasoline, namely 80 and 91 octanes, will be handled. Small aircraft will be serviced from these facilities, and airport tenders will be provided for the servicing of larger aircraft at any point on the airport.

REAL ESTATE

For Sale: In Lafayette, La. beautiful home on corner lot 125x125, attractively landscaped with shrubbery, plants, bushes, lawn, etc. a very pretty home, built with best materials, under architect's supervision, 3 bed rooms, 2 complete baths, rubbertile in kitchen and baths, exceptionally large living room. Call or write for further information. Mike Donlon, Realtor, Lafayette, La.

For Sale: In Lafayette, La. beautiful two story colonial home, one of finest in Lafayette, large corner lot with plants, flowers, shrubs, etc. nicely landscaped, nice trees. Convenient location to schools, churches etc. good floor plans, two complete baths, one on each floor. Can be arranged into 2 separate apartments. Call or write for further information. Mike Donlon, Realtor, Lafayette, La.

NOTICES—SERVICE

Manufacturers Representative needs new accounts, sell through leading supply companies only, calling on drilling contractors and oil companies. Address: Box 76W, c/o World Oil, Houston, Texas.

NEW CLOSING DATE for The Trading Post

Effective with the October issue, advertisements in The Trading Post section of WORLD OIL must be received by the publisher on or before the 5th of the month preceding date of issue.

New Books

Tooling Dictionary

A book which should prove popular with engineers is Torger G. Thompson and Ross A. Peterson's "Illustrated Jig-Tooling Dictionary." This new book gives in convenient reference form a wealth of illustrated factual data for toolmakers, tool engineers, designers, and others engaged in tool and jig construction. Over 1000 tooling terms covering all the common and many of the special types of tooling and tooling procedures are illustrated by functional drawings each accompanied by a clear-cut explanatory legend.

In addition to terms referring to tools, parts, and operations, many allied terms and procedures commonly used in connection with tooling are included such as mathematical procedures, formulas, the properties and treatment of metals, standards and basic dimensions, and terms used in connection with plastic forming processes, welding, technical drawings and blueprints.

The MacMillan Company, 60 Fifth Avenue, New York 11, $7.50.

Alloying Materials

"Molybdenum: Steels, Irons, Alloys," by R. S. Archer, J. Z. Briggs and C. M. Loeb, Jr. describes varied applications of molybdenum as an alloying element, covering a wide range of materials from wrought to cast steels and from cast iron to nonferrous alloys. The major emphasis has been placed on the presentation of the fundamentals that must guide all engineers, designers, and metallurgists in their selection of the most suitable materials for a given application.

In the past, many books have been confined to the presentation of uncorrelated data on specific compositions, each of which has been treated as a self-sufficient entity. In the present book, an attempt has been made to show the fields of similarity and dissimilarity of the various materials and to indicate some of the factors that may affect the choice of the most economical material for a specific part.

The scope of the book is illustrated by the main section headings: Technical Effects of Molybdenum, Fundamental Effects of Heat Treatment on Microstructure, Addition of Molybdenum, Wrought Alloy Engineering Steels, Wrought Corrosion Resistant Steels, Wrought Steels for Elevated Temperature Service, Tool Steels, Steel Castings, Cast Iron, Special Purpose and Non-ferrous Alloys.

Considerable recent information is included, not only on the more prominent developments, such as the gas turbine steels and alloys, but also on the work that has served to clarify the factors affecting the service life of the lower alloy steels. The references to current literature are adequate to facilitate further reading by anyone who desires more detailed data.

A valuable addition is the compilation of much rather obscure, hard-to-find information on some of the specialty applications, such as exhaust valves, elevated temperature springs, ferritic gas turbine steels, high permeability alloys, contact materials, grid wires, and prosthetic alloys. The appendices include data on standard compositions of American, British and French engineering steels, working stresses from the Boiler Code, conversion tables, and the physical properties of metallic molybdenum.

Climax Molybdenum Company, 500 Fifth Avenue, New York 18.

S.E.G. Index

A new cumulative index, containing listings of all geophysical data published by the organization since 1931, has been published by the Society of Exploration Geophysicists. Topics are indexed by subject, author, and volume of *Geophysics*, the society's journal. In addition, the cloth bound volume carries a complete Geophysics Patent Abstract Index, which lists abstracts of all geophysical patents as carried in *Geophysics* since 1939.

Society of Exploration Geophysicists, Box 1614, Tulsa, $2.00 to members, $2.50 to non-members.

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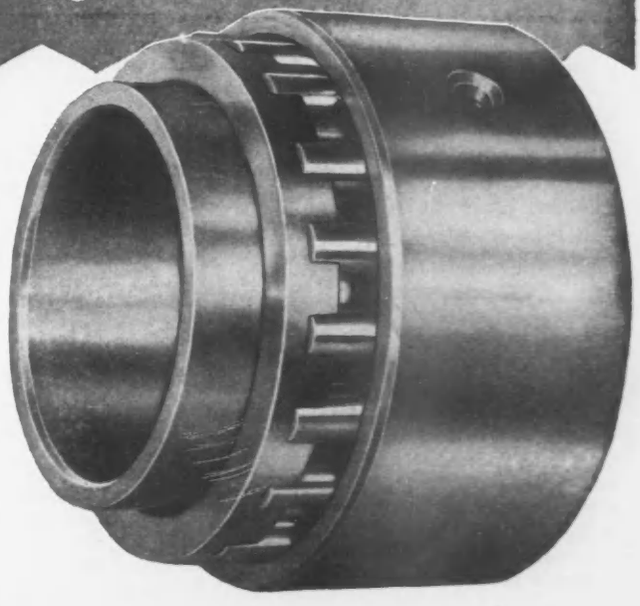

Here is a "super" bearing designed especially for super heavy-duty service. Its simple construction, absolute precision and tremendous strength assure smooth, dependable performance in the heaviest machinery under the most difficult operating conditions. Complete technical data furnished without obligation. Write.

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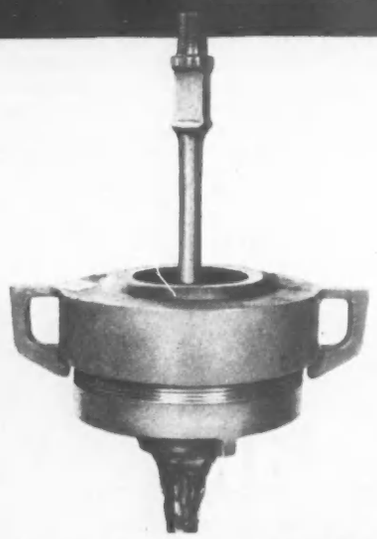

Here's the compact Sucker Rod Wiper designed as *Well Pullers* wanted it. Short overall height, 4", just right height for wrenching rods. Weight complete, only 36 lbs. Easy to handle, comes mounted on pony rod ready to be used, if so ordered. Tough, natural rubber wiping webs squeegee rod, box and square free of oil. No oil leaves hole or flips on crew... Rubbers stand enough pressure to take oil to tank or sump if well flows. Wipes any size rod—wiping diameter expands from ½" to 2⅜".

The Wiper Housing contains two rubber wiping elements. It is furnished complete to make up on all standard pumping tees. The Plain Cap type is shown above and the Table Plate Head model, below:

The cut away drawing shows sturdy construction of both types. The handy Table Plate Head holds rod tools and elevators.

Write for Catalog 310, code names and complete specifications or see your Patterson-Ballagh man.

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SQUEAKS from the BULLWHEEL

Reservation, Please

The phone rang and the Salvation Army worker picked up the receiver. "Is this the Salvation Army?" a voice asked.

"Yes," the worker replied.

"Is this where you save fallen women?"

"Yes."

"Well, how about saving me a couple for Saturday night?"

Close Race

Two men were flying East in a passenger plane, making the first air trips of their lives. The plane touched down at St. Louis and a little red truck sped out to its side to refuel it. The plane landed again at Cleveland, and again a little red truck dashed up to it. The third stop was Albany and the same thing happened.

The first of the two men looked at his watch and turned to his companion. "This plane," he said, "makes wonderful time."

"Yep," said the other, "and that little red truck ain't doing bad either."

Just Reason

The visiting preacher had just finished a chicken dinner. While he was looking out the window he saw a rooster strutting about the yard.

"That's a mighty proud looking rooster," he remarked.

"Yep," said the host. "One of his sons just entered the ministry."

Crazy Waste

A man went into a bar, ordered a Martini, drank it, nibbled the rim of the glass and threw the stem over his shoulder. He continued this for about six Martinis and noticed that the bartender was staring at him.

"I guess you think I'm crazy, don't you?" he asked.

"I sure do," replied the bartender. "The stems are the best part."

I Really Mean It

Bill: "Here's a letter from your wife saying that you are the father of a ten-pound boy."

Jack: "Does she say anything else?"

Bill: "That's all, except at the end of the letter she says TRULY YOURS."

Naked Truth

Voice (to visitor at the gate of nudist colony): "Whatcha want?"

Visitor: "I want to join."

Voice: "You can't with that blue suit on."

Visitor: "That's not a blue suit—I'm cold."

Almost—

Mother: (from upstairs) "Junior! Are you spitting into the fishbowl?"

Junior: "No, Mom, but I'm coming close."

"It's a unique idea, Jackson, but how are you going to know when he spots oil?"

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